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	Page
Trolley 'Bus *v.* Tramway	201
An I.E.E. Recommendation	202
Supply Authorities, Manufacturers, and Contractors	202
The L.C.C. Says British Goods First	202
What's in a Name?	202
South African Official Contracts...	203
Loan Redemptions in Germany	203
St. Marylebone the All-British	203
A French View of German Industry	203
Water-power Studies	203
Water-power Studies—I, by William T. Taylor (*illus.*) (*concluded*)	204
Electricity at the Paris Agricultural Show, by R. Borlase Matthews	207
The Economic Restoration of Russia	208
Legal...	209
Correspondence—	
The Carelessness of Power Users	210
Arc Welding	210
Not Partnership—a Correction	510
Static Charge in Printing Machinery	210
A Motor-starting Problem	210
The Sale of Wireless Apparatus	210
Business Notes	211
New Underground Rolling Stock (*illus.*)	219
Railless Traction at Birmingham (*illus.*)	220
Notes...	224
City Notes	228
Stocks and Shares	229
Market Quotations for Chemicals and Metals	230
The Magnetron (*illus.*)	231
Britain's Prospects in Argentina...	232
The Development of the Domestic Load...	233
The Physical Society of London (*concluded*)	234
Secrecy in South African Contracts	235
Silvanus Thompson Memorial Lecture	236
The Maintenance of Voltage on a d.c. Distribution System, by P. J. Robinson	237
Reviews	239
New Patents	240
Published Specifications	240
Contractors' Column ... ... Advertisement page xxxii	

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TROLLEY 'BUS *v.* TRAMWAY.

THE large-scale adoption of trolley 'buses by the Birmingham Corporation, described on another page, is a noteworthy event in the modern history of public transport services. It is the first time that a trolley-'bus service has been substituted for an established tramway service, and the results will be keenly watched, because they can be directly compared with those given by the tramway service of which it takes the place. They will inevitably be taken as affording reliable data for comparing the two kinds of transport on the basis of economy. But it is premature to say that because the estimated costs of reconstructing the Nechells tramway route and the estimated costs of the substitution, together with the working costs of each, showed an advantage for the trolley 'bus, therefore the electric tramway must be reckoned out of date for any similar service.

Before the war it was recognised by those who had studied the economics of passenger transport by established services, that the deciding factors in the choice of system were the traffic density, as expressed by frequency of service, and the ratios of capital charges and working expenses involved. Shortly, the tramway required the largest capital expenditure, and therefore the largest annual capital charges, but its working expenditure, including the maintenance items depending upon car mileage, was at a decidedly lower rate. The trolley 'bus required a lower capital expenditure on line equipment, a higher one on vehicles, but on the whole lower fixed annual capital charges, but the working expenses were decidedly higher. The effect of these considerations, valued at prevailing prices and average working costs, &c., was roughly that at a service frequency which varied, under different circumstances and according to different authorities, between 10 minutes' and 20 minutes' headway, the tramway and the trolley 'bus were about equal. For a greater frequency (*i.e.*, a smaller headway), the tramway was economically superior; for a smaller frequency (*i.e.*, a greater headway), the trolley 'bus had the advantage. There were other considerations, especially the prospect of future traffic, whether it would or would not increase and the probable rate of any increase, but the main consideration was that above stated.

Post-war conditions have increased capital expenditure, and capital charges, in great proportion than they have increased working expenses, with the consequence that the service frequency at which the two transport methods balance is now greater; in other words, a greater traffic density is required to justify the selection of the tramway. In the particular case of the Nechells route at Birmingham, it is stated that the estimates showed that reconstruction of the tramway would have cost £54,000 more than that needed to establish the trolley 'bus service, and that the financial result would have been a loss of £3,000 per annum for tramway working, against a profit of about as much for the trolley 'bus working. So nearly as can be judged from these figures, the tramway reconstruction estimate must have been in the neighbourhood of £90,000, which it must be admitted is a rather startling figure for about three miles of single track, with turnouts. Of course no criticism of the estimate is implied by this comment; it is only made to show that for whatever reasons, the cost was much in excess of anything that has been reckoned heretofore. Apparently the estimates must have been based on the material and labour rates of 1920 or 1921, and if priced at current rates would have been decidedly lower. Possibly, too, the estimates included

the cost of improvements to increase the traffic capacity of the route, limited as it was to a five-minute service and apparently inadequate for public requirements, since the 'buses, with a four-minutes' service, are taking more than 50 per cent. greater total receipts and more money per car mile. It must not, therefore, be rashly concluded that the tramway is beaten for services of any less frequency than four or five minutes. The results in working costs of the Birmingham venture will be eagerly awaited and keenly scrutinised; they will be of great value for future guidance. It is especially to be hoped that an attempt will be made to ascertain the additional cost of road maintenance which ought to be charged against the trolley 'buses. It may be noted that the cost of tire maintenance of the trolley 'buses is estimated at about ¾d. per mile, which, by itself, is almost as much as the total costs of tramcar repairs and maintenance at pre-war rates. Tire wear and road wear should bear some proportion to each other. The item of rates and the calculation of the rateable value will also raise some rather nice questions. As is well known, the rates on tramways are in essence an income tax, *i.e.*, they are based on the net income earned. How far this principle will be held as applicable to a trolley 'bus route, and what the result will be in money, may have to be decided by the appointed tribunals. The item is of considerable magnitude at current rates, and, together with paving maintenance, is a considerable handicap upon tramways generally, which in equity ought to be reduced.

An I.E.E. Recommendation.

The Council of the Institution of Electrical Engineers has taken action affording ground for solid satisfaction regarding this matter. On the afternoon of the St. Marylebone Council meeting it too was passing a resolution which can hardly fail to carry weight with its members and thus bring benefit to the industry. The resolution reads:—

"That in view of the present state of trade and employment, the Council request members who place, or who advise upon the placing of orders, to specify, as far as practicable, that the plant and material ordered shall be of British manufacture."

By this wording the request is not limited to those who are interested in the placing of public contracts. It is made to all who place or advise upon electrical contracts for mines, industrial works, and so forth—work which too frequently in times past was placed outside the country and because it was for privately-owned concerns did not come under the searchlight of general publicity.

Supply Authorities, Manufacturers and Contractors.

The lecture by Mr. C. S. Davidson, electrical engineer to Barnes U.D.C., and the discussion upon it, before the Electrical Development Association on February 2nd, broke a considerable amount of fresh ground and at the same time served to keep the E.D.A. lectures from getting into a rut. Without in any way minimising the value of the lectures, some have felt that there has been just a little too much discussion of the qualities which go to make a good salesman and of the elements of salesmanship. It is not suggested by any means that these aspects should not be considered, but for the moment they have been amply dealt with. It was, therefore, natural that a lecture like Mr. Davidson's, which is reported elsewhere in this issue, should be welcomed by way of a change, even if it made a mild attack upon the industry as a whole, and led to what was referred to at the close as a lot of "shooting" at one another across the room.

It can do no harm for the various sections of the industry concerned in the sale of electricity and apparatus to be frank with each other on occasions, and it is quite clear that the differences between the contractors and the electricity supply authorities, mentioned during the discussion upon Mr. Gillott's Institution paper a few weeks back, have yet to be composed. The whole story of the E.D.A. lectures may be summed up in the statement that they have been one continual plea for co-operation between the three sides, *viz.*, supply authorities, manufacturers, and contractors. Mr. Rawlings has certain feelings towards the supply authorities, and his candid—and, we think we may say, designedly exaggerated—comments led to equal, if not greater, candour from other quarters, all of which is really to the good. Things usually get done when there is a stir, although we do not go so far as the works manager we once heard of who thought the way to keep his staff up to the mark was to "kick up hell" once a month. Nevertheless, the candid criticism which we had at the last E.D.A. Conference focuses the position so vividly that it gives the Association an admirable opportunity effectively to play, at least, one part of the rôle for which it was created. There are clearly several fundamental difficulties between contractors and supply authorities which will have to be disposed of before the fullest results can be expected from selling campaigns and the general development of the use of domestic electrical apparatus. There are also problems between the manufacturers and both the other parties which will have to be dealt with, and our hope is that the E.D.A. Conferences will bring home to the three of them the fact that to dally with these problems is not the way to get them settled. The issues are clear enough.

The L.C.C. says British Goods First.

Among the other welcome indications of municipal intentions to give preferential consideration to British tenders in order to reduce the present unemployment in the United Kingdom, is a decision arrived at by the Highways and General Purposes Committees of the London County Council. A rule has been adopted that the names of foreign firms and the British agents of foreign firms shall not be included in the selected lists of firms to be invited from time to time to tender for tramway stores and materials. As a safeguard in the public interest, however, the door has been left open for such firms or agents to be permitted to tender, by invitation, "in any case in which it is considered expedient to do so." But where it is deemed necessary, or desirable, to issue such invitations for foreign concerns and their British agents to compete, the proposition is to be laid before committee first, so that the determination so to proceed, and the responsibility, shall rest with the committee and not with the general manager of the tramway department or the chief officer of stores. No doubt the London County Council's lead in this matter will influence other authorities to keep their stores and other requisitions for British execution, while reserving the right to exercise special discrimination in special cases.

What's in a Name?

It is of course perfectly true that a rose by any other name would smell as sweet, but that does not do away with the desirability for requiring unnaturalised aliens to retain and use their original cognomen. Such an obligation is most necessary in order that we may be able to know with whom we are doing business, especially bearing in mind the difficulties of war-time in this connection. We are not denying that there may be very good reasons why one of our own race, or any other for the matter of that, should wish to change his name, as, for example, when a man of the 'good old British name of Bugg thought well to announce that in future he would be known to all and sundry as Mr. Norfolk Howard. Such a change may be perfectly justifiable on personal grounds, may harm nobody, and need not lead others into business transactions that they desire to avoid. But there is an Aliens Restrictions Act in operation, and a Business Names Registration Act is on the Statute Book, and those who fail to comply with their requirements must pay the penalty. We read in *The Times* that at Old Street Police Court on Saturday last, one Carl Frederick Adolph was summoned for using the name of Fenwick, contrary to the Aliens Restric-

tions Act, and for carrying on business in the name of Charles Adolph Taylforth & Co. The police evidence showed that after complaints had been received regarding transactions through an advertisement in a wireless paper, defendant was seen, and in reply to questions he said he was Chas. Fenwick, and was really the firm of Taylforth & Co., Mr. Taylforth being a working partner. He stated that he was a German, naturalised British, but later said that he was not naturalised. When Taylforth was seen, it was ascertained that he was simply working for the defendant, and apart from that had nothing to do with the business. The magistrate was informed that there was no suggestion of unlawful dealing, and he fined the defendant £2 10s. on each summons.

South African Official Contracts.

We reprint on another page some important comments in regard to South African public contracts, from our contemporary, the *British and South African Export Gazette*. We disapprove entirely of unnecessary secrecy in the placing of contracts where public money is involved. Wherever it is permitted, there is almost certain to be discontent and suspicion—possibly without any cause whatever regarding the actual contract details or practice. There is, of course, a stage at which no sane man would expect details to be divulged, but after contracts have been actually placed, or even definite recommendations have been made, the full light of publicity ought to be allowed free play. The public is entitled to the information, and the manufacturer or trader should be allowed to enjoy the full benefit of his success.

Loan Redemptions in Germany.

Many German companies have recently given notice of intention to redeem their debentures and mortgage loans which were raised in gold marks. If repaid in paper marks, as appears to be the decision, the companies will earn enormous profits owing to the depreciation of the mark; but the holders of the loans will receive comparatively small sums by way of redemption in paper marks. Although the companies under present circumstances have at disposal an easy method of liberating themselves from liabilities in gold, it is thought that those which do so will find it difficult to raise fresh loans and mortgages in the future when they are compelled to have recourse to this procedure. Among the concerns which have under consideration the question of giving notice of redemption, as far as is admissible, are mentioned the names of the Siemens & Halske Co., the Siemens-Schuckert Works, and the Berlin Elevated and Underground Railway Co.

St. Marylebone the All-British.

We heartily congratulate the members of the St. Marylebone Borough Council on the public spirit which they have displayed in deciding to accept a British tender for a 12,500-kW turbo-alternator plant required in connection with their 1923 extension scheme, at £45,000, notwithstanding that a foreign firm quoted £39,728. The full list of tenders was given in the Electrical Review for January 26th, p. 142. It will be remembered that the Electricity Committee put forward alternative recommendations, British and Swiss, and left it to the Council to decide which should be accepted. The time required for delivery was the same in both cases (ten months), and the same make of condensing plant was included. We congratulate the Council on having arrived at its decision without a lot of beating about the bush. The conviction that the present state of trade and the number of our unemployed called for special consideration led to the acceptance of the British tender almost without discussion; indeed an amendment to send the order to Switzerland did not even have a seconder. This is not in the least due to any antipathy to the Swiss concern. We regard it as purely and simply a definite determination to help British industries in the present crisis. The situation is such that whatever may have been considered right in the past, and whatever may be thought politic at some remote date, the need of the moment is that British works shall be as far as possible carried out by British workmen. That there is another side to the case we know well enough—but it is not a side to worry about just now. The list of tenders as published has doubtless been studied closely both by manufacturers who by seeing that the percentage of profit allowed for in their tenders is not too high can help councillors to fulfil their present duty of supporting Home industries, and by engineers who have to fortify themselves against the point sometimes raised by the locally-minded councillor that a lower price is a local advantage outweighing national considerations. The action of St. Marylebone, following upon a series of similar municipal decisions regarding smaller contracts during the past twelve months, affords a courageous example which may well be followed where the national need for work has to be weighed against the local advantage accruing from a low foreign price.

A French View of German Industry.

M. Charles Laurent, president of the Compagnie Francaise Thomson-Houston, who recently paid a visit to Germany, made a remarkable reference to the developments in the latter country, at the recent extraordinary meeting of his company. After mentioning the milliards of marks devoted to the reconstitution of the German merchant fleet, the president stated that Germany had undertaken the construction of a vast underground telephone network, having expended over 10,000,000 gold marks alone on the establishment of a cable between Berlin and Magdeburg and Hanover. The armistice had scarcely been signed when the work of extending the cable system to Cologne was pushed on, together with many ramifications; and that country was now in course of making extensions to Mayence, Wiesbaden, Frankfort-on-Main and Carlsruhe, the expenditure amounting to many milliards of marks. At the same time, apprehensive that the production of coal would not suffice for the needs of industry, the authorities in Berlin had decided to meet the case by utilising to the utmost the hydraulic power capable of being yielded by some of the rivers. A gigantic programme in this direction was in course of execution over a length of 1,686 miles. The works comprised a junction of the Neckar and the Danube, the Rhine and the Danube, the Weser and the Main, and the Elbe and the Oder, and the canalisation of the Upper Danube, the Neckar, the Ruhr, and the Lippe. All these works would not only facilitate the river traffic which was already considerable, and open up new markets towards the East for German trade and commerce, but would also place at the disposal of the Germans more than 500,000 h.p. of water power. The expenditure on all these works, the president remarked, was being made by a country which pleaded poverty to escape from solemn obligations, and which refused to repair the ruins in the unfortunate provinces in the North and East of France.

Water-power Studies.

So much attention has been attracted to the subject of water-power of late that no apology is necessary for placing in our readers' hands information which will assist them in developing available water-powers on sound lines. The subject is one on which but little reliable information is available; published data regarding the flow of water in pipes, for instance, differ widely amongst themselves, and are mainly empirical. The only safe guide in designing a pipe line is knowledge gained in the field, and we are glad to have the assistance of Capt. W. T. Taylor in providing a series of articles on various aspects of the water-power problem based on a remarkably extensive experience in planning and carrying out hydro-electric schemes in foreign lands. The first of these "Studies," which is concluded in this issue, contains some valuable diagrams which will be found to provide short cuts to a number of essential calculations, and to be applicable to a wide range of conditions.

E

WATER-POWER STUDIES.—I.

Pressure Pipe Lines.

By WILLIAM T. TAYLOR, M.Inst.C.E., M.I.E.E., M.Am.Soc.C.E.

(*Concluded from page* 166.)

To reduce the cost, a rather common fault is to make the pipe too thin where no great strength is wanted. The strength of riveted pipes should be such as to withstand from 55,000 to 90,000 lb. per sq. in. pressure. The price of metal is not a constant for all diameters, it is usually less for large pipes of thin metal than for small pipes of thick metal.

Knowing the area of a pipe ($a=.7854d^2$), see fig. 2, and the quantity of water flowing ($q=a\,v$), the velocity v is obtained by dividing the quantity q by the area a of the pipe, that is, $v=q/a=q/(\pi/4)\,d^2$. Thus, for a given quantity of water, the size of pipe can be determined (see fig. 1) when the velocity or speed of the water is known. This velocity ordinarily varies for the different installations from a minimum of about 2 ft. per second to a maximum of about 7 ft. per second, or even more, the *average* being about 4 ft. per second. From fig. 1 it will be noted that for a flow of 3 ft. per second, the flow in cu. ft. per minute about equals d^2. Low velocity has a range of about 2 to 3.5 ft. per second; medium velocity about 3.5 to 5.5 ft. per second; and high velocity of water a range of about 5.5 to 12 ft. per second. For low speed of the water it is necessary to have low head, large diameter of pipe, great length of pipe line, many bends in the pipe line, variable loads, and low load factor. On the other hand, high speed of water necessitates high head, small diameter of pipe, short pipe line, few or no bends, steady loads, and high load factor. Judging from these two extreme conditions, it is evident that conditions arise in practice whereby several of these variables overlap. While a high velocity entails a considerable head loss, a low velocity necessitates a larger pipe, and this increases the cost. The pipe velocity and slope are both fixed by the volume of water to be carried and by the diameter of the pipe, that is, $v=q/.7854\,d^2$. For a low-head installation a relatively low velocity should be used, because the loss of head will then form a much larger percentage of the gross or total head than for a high-head installation. In a high-head pipe line of great length it is more economical to use a relatively smaller diameter and greater velocity at the bottom of the pipe line where the pressure is higher and the pipe shell thicker. From fig. 2 it will be seen that with static heads less than 160 ft. the thickness of the metal required is less for all sizes than that necessary for durability and mechanical requirements alone. It is usual to allow a minimum of about 3/16 in. thickness for pipe up to about 12-in. diam., 1/4 in. for pipe up to 60-in. diameter, about

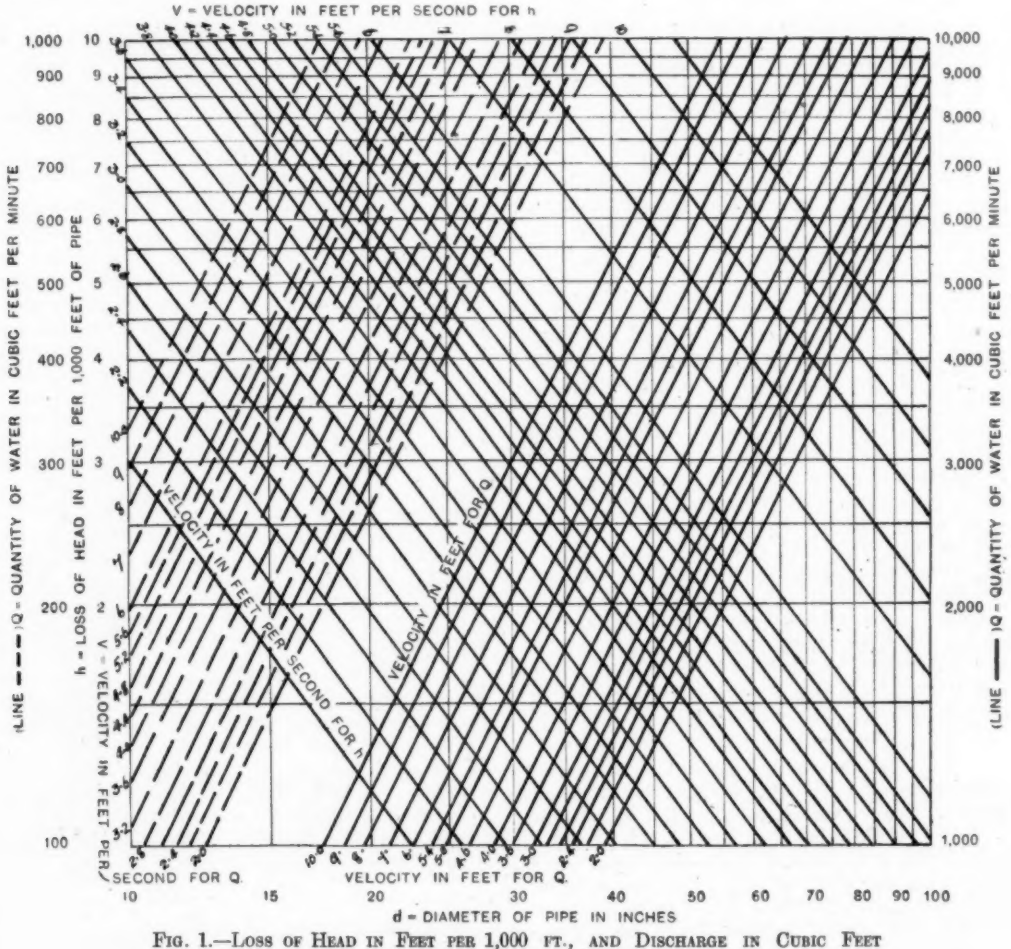

Fig. 1.—Loss of Head in Feet per 1,000 ft., and Discharge in Cubic Feet per Minute, for Riveted Steel Pipe.

3/8 in. thickness for larger pipes up to about 100-in. diameter and, for pipes over 120-in. diameter, a minimum of 1/2 in. thickness of shell is usually employed. For a given head, it will depend on the type of joint. For instance, assuming an extreme static head of 250 ft. in each case, we have the following thicknesses of shell for different types of joints (see fig. 2):—

Type of joint.	(a) S.R.L.	(b) D.R.L.	(c) T.R.L.	(d) D.R.B.	(e) T.R.B.	(f) Q.R.B.
Diam. of pipe in in. 48...	1/4	1/4	1/4	1/4	1/4	5/16
" " " 60...	1/4	1/4	1/4	5/16	5/16	11/32
" " " 72...	1/4	5/16	5/16	11/32	3/8	13/32
" " " 96...	5/16	7/16	7/16	13/32	1/2	17/32
" " " 120...	7/16	1/2	1/2	1/2	5/8	11/16

Wherein *a*, *b*, *c* are single, double, and triple *lap* joints respectively, and *d*, *e*, *f* are double, triple, and quadruple *butt* joints respectively. Obviously, the actual working head is 144 ft. for (*a*) and 235 ft. for (*f*). When high efficiency is desired, the lap or single butt strap joint should not be used. For such cases, double butt straps with three, or even four, rows of rivets on each side are often employed. The efficiency is thus raised from 57.7% for the single-riveted lap and 74% for the double-riveted lap and 75% for the triple-riveted lap, to 82% in the case of the double-riveted butt joint; 87.5% for the triple-riveted butt joint; and 93.7% efficiency for the quadruple-riveted butt joint. Thus the efficiency is increased from 57.7 to 93.7% respectively, or 36% increase. For equal pressure conditions, the quadruple-riveted butt is generally the cheapest type, while the single-riveted lap joint, from the viewpoint of economy for high and medium head pipe lines, is usually limited to the upper or the top section. In terms of relative safe working head, the advantages of the different types of joints can best be understood from the following table; thus, taking *equal* static head of 425 ft.:—

Type of joint.	S.R.L.	T.R.L.	Q.R.B.
Diameter of pipe	36 in.	36 in.	36 in.
Thickness of shell	1/2 "	1/2 "	9/16 "
Cost per 1,00. ft. at 4d. per lb. in place	£5,000	£4,250	£3,500
£5,000 will purchase	1,000 ft.	1,176 ft.	1,430 ft.

Losses in riveted pipe lines produced by eddies are due to rivet heads in both circumferential and longitudinal joints, longitudinal butt strap ends, and abrupt changes in size of the ends of sections which require long, tapered reducers. Where sections change in diameter, long tapers are necessary to avoid losses of head due to impact and swirls. Head loss due to an enlargement is usually more serious than that due to an abrupt contraction. Very often welded joints are employed at the bottom section or sections of high-head pipe lines. In actual practice the *overall* efficiency of pipe line varies from about 2% to about 10%, the former value for good design and the latter value for poor design and long pipe lines. The theoretical power from the water, conducted and delivered through a pipe is $[(62.4)\ Q\ (H-h)] \div 550 = [(Q)\ (H-h)] \div 8.82$; wherein H is the gross head and h is the head lost due to friction, &c. Hence, *power loss* is

$$P = (62{\cdot}4)\ Q\ he/550 = Q\ he/8{\cdot}82 = Q\ he';$$

$$\text{where} \begin{cases} e' = e \times {\cdot}1134 \text{ (h.p)} \\ e' = e \times {\cdot}10 \quad \text{(e.h.p.)} \\ e' = e \times {\cdot}0854 \text{ (kW)} \end{cases}$$

Example I.—The surveyed head is 400 ft. and the length of pipe line 1,140 ft., the quantity of water available is 40 cusecs (2,400 cu. ft. per minute); the velocity of water in the pipe line will average 4 ft. per second for full-load conditions; a double-riveted

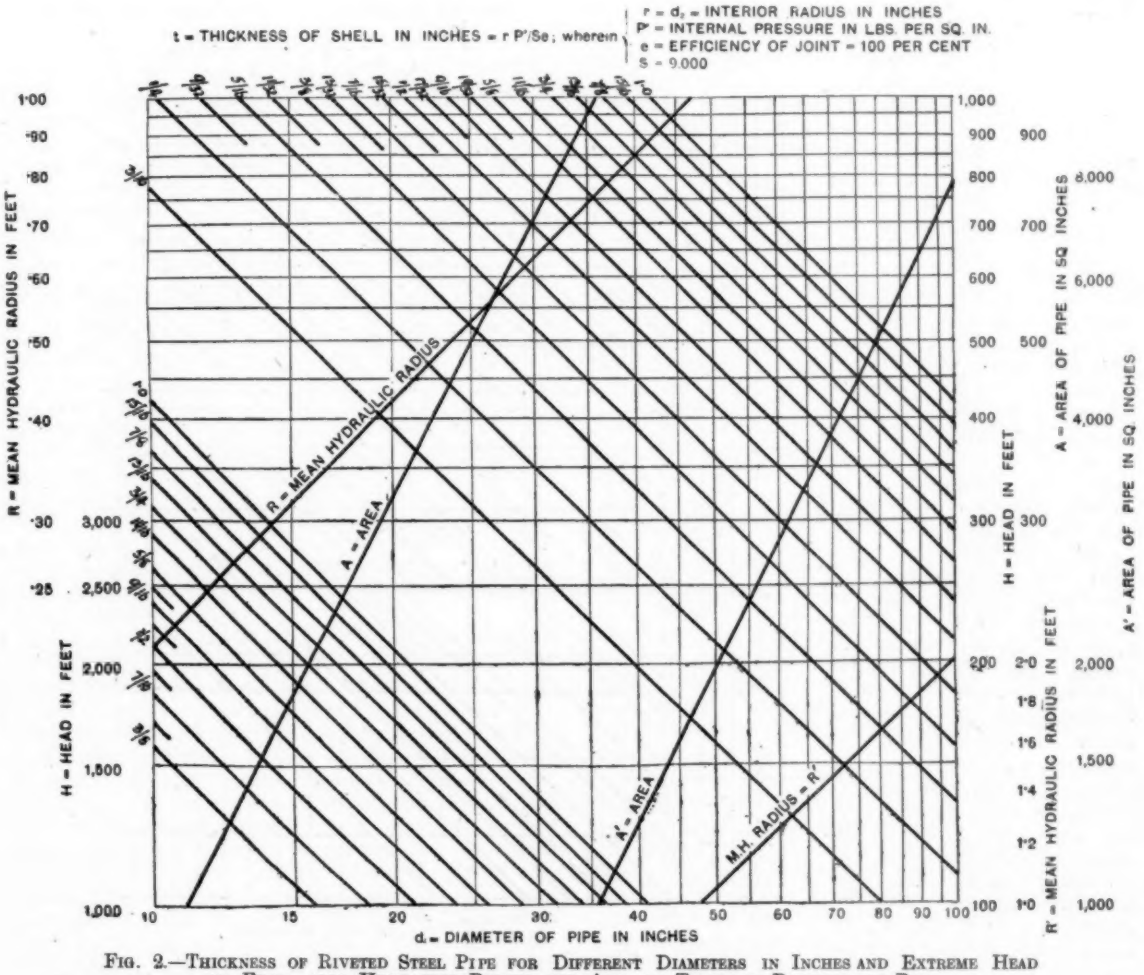
t = THICKNESS OF SHELL IN INCHES = r P/Se; wherein
r = d/2 = INTERIOR RADIUS IN INCHES
P = INTERNAL PRESSURE IN LBS. PER SQ. IN.
e = EFFICIENCY OF JOINT = 100 PER CENT
S = 9,000
R = MEAN HYDRAULIC RADIUS IN FEET
H = HEAD IN FEET
A = AREA OF PIPE IN SQ INCHES
A' = AREA OF PIPE IN SQ INCHES
R = MEAN HYDRAULIC RADIUS
A = AREA
A' = AREA
M.H. RADIUS = R'
d = DIAMETER OF PIPE IN INCHES

Fig. 2.—Thickness of Riveted Steel Pipe for Different Diameters in Inches and Extreme Head in Feet; also Hydraulic Radius and Area in Terms of Diameter of Pipe.

butt strap pipe is to be employed. What will be the pipe diameter d, thickness of pipe shell t, the total head loss h, power loss P, and cost of pipe c, at fourpence per lb. of metal *in place*? From fig. 1 we find at the intersection of Q=2,400 and V=4, that d=42 in. diam.; we also find from d=42 and V=4, that h=1.7 ft. head loss per 1,000 ft., which makes total head due to friction 1.7×1.14=1.92, or 2.0 ft. (round numbers).

From fig. 2 we find, for a static head of 400 ft. and use of D.R.B. joint of 82% efficiency, the thickness for H=400×.82=328 ft., and d=42 in., that t=5/16 in., and, assuming a chance of water hammer, allow 1/16 more, making t=3/8 in. shell thickness. Fig. 2 is based upon 9,000 lb. working stress S on the gross section and 100% joint efficiency. From fig. 3 we find the weight per ft. of pipe to be 227 lb., and the cost c= £3 15s. per ft. The total cost is £4,310.

Total power lost in the pipe line, assuming 80% efficiency is P=.09 Q H=.09×40×2=7.2 h.p., hence the cost of pipe per h.p. lost is 4,310/7.2 = £60. Also, assuming that power can be sold at £4 per h.p.-year, the annual cost of lost power would be 4×7.2=£29; this capitalised at 10% is £290.

The gross h.p. is 0.1134 Q H= 0.1134 × 40 × 400=1,814 h.p., but, at the turbine shaft, it is .09 Q H = .09 × 40×400=1,440 b.h.p.; the chosen size of generator is 1,000 kW. If the pipe line had been divided into several sections of, say, 42, 40, and 38 in. diameter respectively, and/or the pipe line had been in different thicknesses, such as 5/16, 3/8, in., &c., a saving in metal could have been made.

Example II.—Take now a case where the pipe line is tapered and the thickness of shell is allowed to increase in sections with increasing head. In this example it is assumed that the turbine, when fully loaded, gives 3,720 b.h.p., but, from the actual amount of water required, the gross power involved is 4,650 h.p., for 2,400 cu. ft. per minute (40 cusecs). The surveyed head is 1,025 ft., and *one* pipe line is decided upon. In making a choice of the diameter, the mean speed of water may be taken at 4 ft. per second. Hence, the mean area of pipe for A=Q/V=40/4=10 sq. ft. =10×144=1,440 sq. in.=42 in. diam. (fig. 2). The mean hydraulic radius R=.0208 d= .0208×42=.874 ft. (fig. 2). In this example we shall take the diameter as varying from 36 to 48 inches.

The pipe line is to be divided into four sections (following the hillside topography), 1,200, 920, 600, and 700 ft. respectively in length, and with corresponding heads of 350, 500, 700, and 1,025 ft. respectively. Tabulating these values we have, from fig. 1, the following results:—

Section head.	Section length.	Q.	d.	V.	h.	Total h.
0 — 350	1,200	40	48	3·3	·9	1·08
350 — 500	920	40	42	4·2	1·8	1·656
500 — 700	600	40	36	5·7	4·1	2·46
700 — 1,025	700	40	36	5·7	4·1	2·87

Total h = 8 ft.

To this total head loss (h=8 ft.) caused by friction in the 3,420 ft. of pipe, allow 2 ft. for additional friction due to rivet-heads, bends, and tapered reducers at the section ends, making h=10 ft. From fig. 2 we have:—

Section head.	Type of joint.	H.	d.	t.
0 — 350	D.R.B.	350 × ·82 = 287 ft.	48	5/16
350 — 500	D.R.B.	500 × ·82 = 410 ,,	42	7/16
500 — 700	Q.R.B.	700 × ·937 = 656 ,,	36	9/16
700 — 1,025	Q.R.B.	1,025 × ·937 = 960 ,,	36	13/16

and, from fig. 3, we obtain:—

Section head.	l.	d.	t.	w.	Cost at 4d. per lb.	Total cost.
0 — 350	1,200	48	5/16	195 lb.	£3 5 0 per ft.	£3,900
350 — 500	920	42	7/16	240 ,,	4 0 0 ,,	3,680
500 — 700	600	36	9/16	318 ,,	5 6 0 ,,	3,180
700 — 1,025	700	36	13/16	470 ,,	7 15 0 ,,	5,425

making a total cost of £16,185 for the pipe line.

The total power lost in the pipe line (assuming 80% efficiency) is .09 × 4 × 10 = 36 h.p.

Value of power lost, at £4 per h.p.-year is 4 × 36 = £144.

Annual interest at 7% on investment equals £1,133. Hence, total annual value is the power loss value, *plus* interest value, of £144+£1,133=£1,277.

Different angles of this same problem may be taken to determine *the* most economical size of pipe. We may estimate closer values of d, take two pipe lines in place of one, more pipe sections, other types of joints, different values for costs, for interest, and for energy, &c. The above indicates a simple method which need not necessarily be tabulated as shown here; in fact, it is often better to draw a profile of the pipe line and mark in all the technical and physical data for different principles of economy, remembering that there are several, such as the determination of the size so that the total net annual income shall be a maximum or the percentage return on the first cost shall be a maximum, or that the percentage return on the first cost shall be a specified amount. Circumstances and conditions should decide the requirements for each installation.

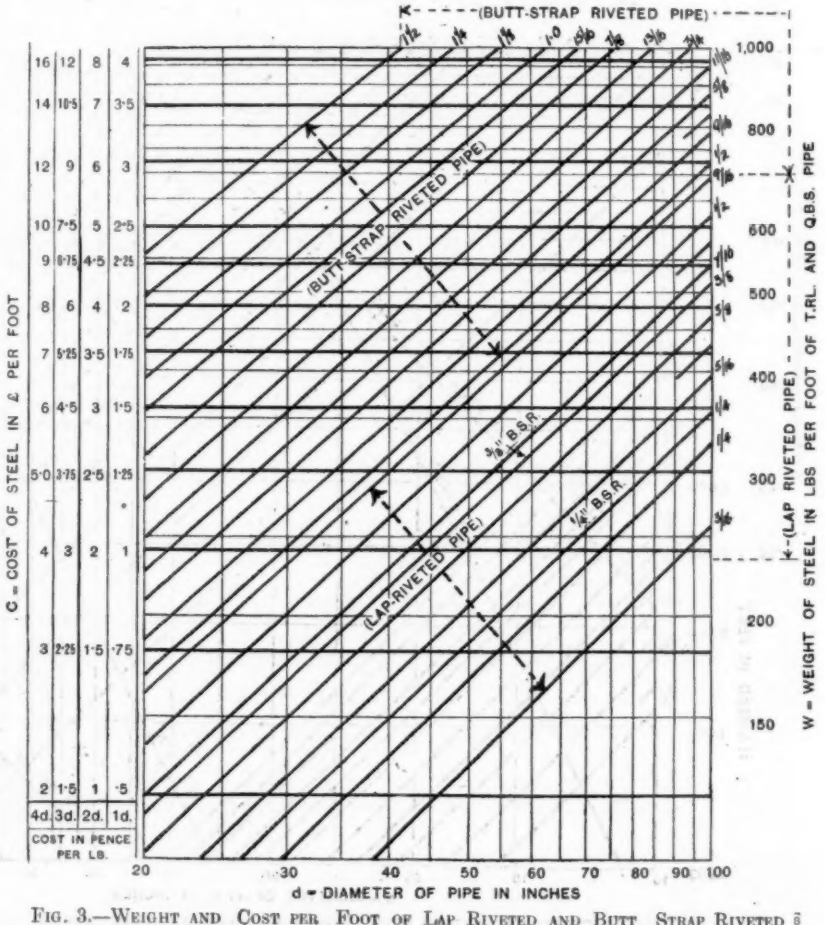
(BUTT-STRAP RIVETED PIPE)
(BUTT-STRAP RIVETED PIPE)
(LAP-RIVETED PIPE)
3/8" B.S.R.
1/4" B.S.R.
C = COST OF STEEL IN £ PER FOOT
COST IN PENCE PER LB.
4d. 3d. 2d. 1d.
W = WEIGHT OF STEEL IN LBS PER FOOT OF T.R.L. AND Q.B.S. PIPE
(LAP RIVETED PIPE)
d = DIAMETER OF PIPE IN INCHES
20 30 40 50 60 70 80 90 100
1,000 800 600 500 400 300 200 150

Fig. 3.—Weight and Cost per Foot of Lap Riveted and Butt Strap Riveted Steel Pipes (complete), including Weight of Rivets and Straps or Laps.

ELECTRICITY AT THE PARIS AGRICULTURAL SHOW.

By R. BORLASE MATTHEWS, Wh.Ex., A.M.Inst.C.E., M.I.E.E., F.R.Ae.S.

Among 864 exhibits of general agricultural machinery at this year's Paris Agricultural Show, nearly 950 electric motors were distributed. This is strong evidence of the eagerness of the French farmer to take advantage of electricity to assist him in his daily work. The number of electric motors is not so high as it would have been at a German show, for the French farmer seems to have had a harder task in re-establishing himself since the war than his prosperous German neighbour, who has had every assistance from his Government. The French Government is now, however, emulating the German Government in facilitating the bringing of central-station supply lines within the reach of those French farmers who have not already got a supply. When one considers the difficulty an English farmer meets with in getting an electricity supply, it is almost like irony to hear that the fund collected by one English town, to help the farmers in one of the war-devastated areas, is going to be expended in providing those farmers with electricity. Thus England is generally paying for advantages for French farmers, which English farmers have to forgo—probably because they have not as yet demanded similar treatment for themselves with sufficient insistency, or, what is more likely, do not fully appreciate the advantages of electricity.

The Agricultural Show this year was held at the Grand Palais, on the Champs Elysées, a building comparable in size with Olympia. A considerable number of oil engines were on view—more than would appear at a similar German show. It was noteworthy that a large number of these were arranged with heavy double flywheels for electric dynamo driving. Naturally, the exhibits of the English and American agricultural machinery did not include any electric motors, for neither of these nations employs electric motors to the extent that is found on the Continent, and the manufacturers have not yet awakened to the fact that the Continental farmer now looks upon an electric drive as an economical necessity.

As regards the electric drives of thrashers, the Show was quite an educational exhibit, demonstrating as it did the gradual evolution that is taking place. One of the latest improvements, which has now been adopted by a number of makers, is to mount the starting switch in a convenient position for the man who is feeding the machine. Thus he has the thrasher completely under his control. In many cases the belt drives from the motor to the thrashing drum were rather short, and no means were provided for taking up the slack. In some cases adjustable spring-controlled idler pulleys were provided to keep the belt at the right tension. The motor housings are being improved, and the motor drive is beginning to look as if it is a part of the thrasher, instead of being tacked on as an afterthought. A certain number of makers provided a large compartment in their thrashers, in which either an electric motor or an oil engine could be installed. Only those who have had experience of practical thrashing can realise what a boon is a self-power-contained thrasher. As soon as the machine is brought into position, it can be set to work, without the wearisome delay required in lining up a steam engine or a tractor. Of course, ball-bearings are a *sine qua non* in a French thrasher.

A large variety of electrically-driven water pumps were on view, chiefly of the direct drive rotary and of the chain helice patterns. Evidently the automatic pressure tank system is greatly favoured—as it should be, for it is a great saver of time on a farm, to be able to get water under pressure equivalent to that of a town main. As water is drawn off from such a system, the motor starts pumping automatically to maintain the pressure; hence pressure water is always obtainable, without excessive storage capacity being needed. A novelty was a deep-well pump, suitable for depths up to 600 feet. The only connections between the pump at the water level and the surface plant were three pipes, one for the delivery of the pumped water and two for operating the pump hydraulically. The alternating hydraulic pressure in these operating pipes was obtained from a double-acting ram pump on the ground level, worked through reduction gearing by an electric motor.

Naturally in a wine and cider country, a number of fruit presses and other similar machinery were shown. The screw-press types were electrically worked by tiny electric motors through multiple speed-reduction gears. The more modern types of hydraulic ram presses were operated by high-speed electrically-driven ram pumps.

Several electrically-operated log cross-cut saws were on show. These are, of course, a modern modification of the American two-stroke petrol engine log-saw type. An electro-mechanical feature of the starters on these saws was the long extended starter spindle, which was brought up to near the centre of the cutting part of the saw, for convenience of control by the operator.

There were no steam ploughs on view, though there was one electric set. Models and illustrations of other electric ploughs were exhibited, but as the French type of electric plough is large and bulky, it could obviously not easily be shown. The electric plough that was shown was a Landrin, equipped with a 20-h.p. motor, and hence comparatively small. It was of the double rope haulage type, of new design.

Several electrically-operated seed dressers, cleaners, winnowers, and sorters were on view. Very little power is required by these machines, hence the small electric motor makes a very convenient and handy driving unit.

Judging by the number of washing machines in operation, the French farmer's wife is taking as kindly to them as the German *hausfrau*. The French machines, however, are nearly all of metal construction, as compared with the popular woodware of Germany. The prices of electrically-driven washing machines are cheaper both in France and Germany than in England. Presumably they are not yet out of the luxury stage in Great Britain, where they cost from £40 to £60, as compared with £10 or £12 (including the electric motor) on the Continent.

There was quite an interesting display of alcohol-making machinery. The apparatus was reduced to simple forms, easily understandable and workable by the ordinary farmer. In this manner they serve excellently as a rural industry for the winter period, and so help the farmer to improve his labour load factor, and provide cheap food for his beasts (in the shape of the residues) and cheap power for his engines (should he be out of reach of a public power supply). However, in England the Excise authorities seem to object strongly to this form of enterprise.

Of course, a number of small electric lighting and power sets, for the use of isolated farmers, were to be seen. The characteristic French design of this plant usually places the cooler or cooling tank between the engine and the dynamo. Normally small petrol engines are veritable dirt collectors on a farm, being full of holes, corners, and odd shapes. However, one design, the Renée, was constructed with a very neat easily wiped-down exterior.

Various types of portable electric motors, on wheelbarrow frames, were available for inspection. These usually provided for one direct drive, and a low-speed countershaft with three sizes of pulleys. On the

majority, the main speed reduction was by means of an endless belt, kept tight by a jockey pulley. In one ingenious form of construction the supporting arms of the countershaft were mounted concentrically over the main bearings of the motor. An adjustable clamp permitted of a certain amount of alteration of position of the countershaft (which ran in ball bearings).

One very convenient farmer's machine was a combined firewood saw, with a firewood splitter behind. Of course, a large number of other farming machines were electrically operated, such as cream separators, bottle washers, and cattle food preparing machinery; however, space and time do not permit of further description here.

A visit to this Paris Show certainly gave a good insight into the rapid progress the French farmer is making in applying electricity to his daily work. Still it was evident that all French farmers were not progressive, for horse treadmills were on view. On the other hand, the village blacksmith was invited to take up electric welding as a part of his daily routine—and why should he not, for the simple work that he usually has to tackle? Admittedly he should not attempt the highly skilled work to which he is normally unaccustomed.

THE ECONOMIC RESTORATION OF RUSSIA.

(From a Correspondent.)

If it is possible honestly to believe the statements made in the official Russian newspapers, a beginning has already been made in connection with the economic restoration of that country. As an illustration of a recent Soviet attempt to show what is being accomplished at the present time, attention may be directed to a supplement which was issued by the official organ of the Soviet Council of Labour and Defence on the occasion of the assembly of the representatives of the Russian republics (the tenth All-Russian Assembly of the Soviets) in Moscow last December, when it was provisionally agreed to consolidate the republics into a federated Soviet Republic. The supplement consists of eight pages of the size of leading London morning newspapers, and six of these are entirely occupied by reproductions of photographs. The supplement deals with the work of economic restoration by the Soviet Federation as it exists at the present time.

The first page is devoted to photographs of the leaders of the various branches of the national economy. The second gives views of the South Russian coal mines in the basin of the Donetz, showing a coal-cutter at work, the work of laying the foundations of a new winding engine at one of the pits, coke ovens in activity, miners at work at the face, parts of a turbine, &c. On the third page appears views of the Grosny petroleum wells and refineries, views of metal rolling in the Ural, and of generators in a power station. The fourth and fifth pages are occupied by views of a chemical institute, sugar-beet cultivation and sugar works, an electric plough at work, the Russian State Bank administration and interior of the bank's offices; the big Shabolvski radio station at Moscow, the unloading of locomotives from a ship at Petrograd, ice breakers, &c.

Leaving the question of the photographs to create whatever impression the reader may wish to draw from them—in my opinion they were certainly prepared to impress the representatives who journeyed to Moscow from remote regions of Russia—it may now be well to pass on to the consideration of the problem of manufacturing in Russia.

Present Electrical Production.

The electrical industry is at present divided into four so-called trusts or groups of works, each group being under the sole control of one administration.

These groups are:—The Petrograd Heavy Electrical Engineering Trust, the Central Heavy Electrical Trust, the All-Russian Trust of Light Electrical Engineering ("Weak Current Appliances), and the Accumulator Trust. Owing to competition between the first two mentioned, it is considered probable that they will be amalgamated into one group in the future.

At the beginning of 1921 the number of workpeople employed in the electrical industry in general was 7,500, or 51 per cent. of the number engaged in 1913. By far the largest number of the workers is employed on the production of dynamos, motors, &c.; the output of telephone and telegraph apparatus and of other departments of the "weak current" branches occupies the second place, while the third position is taken up by accumulators, in which branch only about 250 persons are employed.

According to the official organ of the Soviet Council of Labour and Defence, the total production of the electrical industry in 1922 can be provisionally estimated at a value of 16,000,000 gold roubles on the basis of the 1913 price lists, or about 30 per cent. of the output in 1914.

If it is borne in mind that the value of the electrical production in 1920 only amounted to 5.4 million gold roubles and to 8.7 millions in 1921, it is considered that the provisional figures for 1922 show that great progress has been made.

The development of the production is dependent in a large measure upon an increase in the efficiency of the workmen. This efficiency in 1920 is said to have only been 20 per cent. of the level of pre-war days, but it rose to 60 per cent. in 1922. The greatest efficiency in 1922 was shown among those engaged on the production of light electrical apparatus, and an augmentation was also noticed in the efficiency of the men on dynamo and other heavy work, the manufacture of cables, lamps, &c., but the production of accumulators declined mainly owing to the scarcity of raw materials.

Despite the considerable success achieved in the departments of production last year, the situation of the electrical manufacturing industry is officially stated "to continue to be difficult." There is a lack of working capital, the sales of manufactures are slight, and there is an inadequate supply of raw materials, particularly electrolytic copper.

The Electroforce Works No. 1 (the former Vek) is claimed to be the largest electrical manufacturing undertaking in Soviet Russia. Notwithstanding the transfer of the works in 1915 from Riga to Kharkoff and the general confusion, it is stated that this works has absolutely maintained its former technical position. The value of the output of the works on the average of the years 1911-1914 amounted to 8,655,000 gold roubles, with 2,000 workmen. In 1915 the value was 3,093,000 gold roubles; in 1916, 2,952,000 gold roubles; in 1918, 579,000 gold roubles for a year of three working months; in 1921, with 700 men, the output reached 1,123,000 gold roubles; and with 1,150 men in 1922 the value of the production is estimated at 2,050,000 roubles. It is considered that these and other figures which accompany them, referring to the average output per workman in the same period of years, show that in those cases where the conditions of production correspond with the conditions of peace time, the efficiency of labour is normal.

The Donetz Coal Mines and Ironworks.

Referring again to the previously-mentioned official supplement, in the matter of the collieries in the basin of the Donetz, it appears that the work of electrification of the pits in the year 1921-22 met with considerable

difficulties in consequence of the scarcity of materials and of labour.

The erection of turbo-generators, boilers, condensers, &c., was proceeding at the Briansk and a few other mines in November last, together with works in connection with sub-stations and the installation of transmission lines. Still, these works do not appear to be either very comprehensive or to apply to many mines, and it looks as if many years will have to elapse before it will be possible to overcome the existing difficulties arising from the shortage of materials and of labour, and before the output of the pits will be substantially increased.

The production of coal in the Donetz basis is expected to have reached last year the level of that in 1921, while the iron and steel works in the same region are said to have achieved much success in 1922 as compared with the previous year.

The Question of Electrical Exports.

A word in conclusion may be said in connection with a report published last week by a Soviet-disposed Russian journal published in Berlin. The statement is to the effect that the Russian Electrical Trust (apparently the Central Heavy Electrical Engineering Trust is referred to) has entered into a contract with the Constantinople Export Co., which aims at the export of Russian electric motors and electrical apparatus to the Balkan States. The newspaper also states that the Trust has obtained good results in the matter of the production of insulators for high pressures of types invented by Russian specialists, and to have also increased the output of insulators of the Juillet type, and that of electric cable.

As has already been mentioned, the Russian electrical industry is in a difficult situation, and there is a scarcity of sales of manufactures. Bearing this fact in mind, there seems to be just a possibility that an element of truth exists in the assertion of the Russian newspaper which is issued in Berlin. But having regard to the absence of an abundance of raw materials, it would appear that the element of export business for the Kharkoff works, which is apparently the one concerned, must be insignificant at the present time and remain so for a long time forward

LEGAL.

Application by the Metropolitan Electric Supply Co., Ltd.

What was described by the Marylebone magistrate (Mr. Cancellor) as a "big question" was raised at his court last week when counsel, on behalf of the Metropolitan Electric Supply Co., requested that, inasmuch as the registered offices of the company were within the jurisdiction of that court—at Stratford Place, W.—in all cases where consumers failed to pay their accounts they should be summoned at that court for recovery, no matter in what part of London the consumers lived or incurred the debt. He maintained that the contract was made and broken with the company at Stratford Place, and that it was the duty of the debtor to pay the company there.

Mr. Cancellor: You are practically asking me to say that all the electric light summonses for your company for all over London shall be taken here. But we have to distribute the work of the Metropolis among the various courts. Besides, there are other companies who might also claim to be entitled to have their summonses heard here, simply because their registered offices are in this district. It is rather a big question, and I am not prepared to give a decision until I have consulted my colleague.—*Morning Post*.

W. T. Kerr Committed for Trial.

On Friday last the Hereford magistrates committed Walter Talbot Kerr, the former electrical engineer to Hereford Corporation, to take his trial at the Assizes on the charge of having converted to his own use sums amounting to £1,651, moneys of the Hereford Corporation.

Acording to the report in the *Birmingham Post*, four charges of fraudulent conversion were preferred:—(1) Between June 22nd, 1920, and September 23rd, 1920, sums of £90 and £810; (2) on May 28th, 1920, the sum of £250; (3) on July 6th, 1920, the sum of £400; and (4) on December 12th, 1920, £101 7s. 7d.

Mr. Mickleth waite (for the prosecution) said the prisoner was appointed electrical engineer of Hereford, in 1904, at a salary of £200 per annum. Through his ability and skill his salary rose until he was in receipt of £700 per annum. The Council had implicit trust in him, and he had a good deal of freedom. Unfortunately it appeared that that trust had been misplaced. If his (counsel's) instructions were correct, there could be very little doubt that Mr. Kerr was engaged in systematically robbing the town of Hereford of substantial sums of money. Counsel related an episode in which he alleged Mr. Kerr, after selling certain electrical plant, reported the matter to the Electricity Committee, and was congratulated on the transaction, his statement being that he had sold it at a price above what it cost. At the time he made the report that he had sold a machine for £650, he had received £900 from the purchasing firm, and the amount had been paid into his private banking account without being disclosed to the committee. His dealings had been carried out with a firm at Swansea, a firm at Birmingham (Mr. F. Gilman), and a Hereford firm. One of the things he sold had not been paid for, and he entered it in his accounts as "engine-room stores."

Evidence was called that the cheques had been paid to the accused, and had not been accounted for to the Corporation.

Prisoner said he was not guilty and reserved his defence.

Permission was granted for the prisoner's bank account to be examined.

Bail was allowed, but was increased to £3,000. Kerr himself in £1,500 and two sureties (Mr. C. Baker and Mr. Machin) in £750 each.

British Thomson-Houston Co., Ltd., v. Irradiant Lamp Works, Ltd., and Other Companies.

In the Chancery Division, on Friday, Mr. Justice Sargant, on the motion of Mr. Travers Watson (for the plaintiff company), the defendants' counsel consenting, gave judgment for the plaintiffs, restraining the defendants from infringing the plaintiffs' patent relating to leading-in wires for electric lamps. The question of damages was to be the subject of inquiry.

Mr. Terrell (for defendants) in consenting said he understood a dozen lamps were sold.

In a similar action, by the same plaintiffs, against the General Electric Engineering Co., his Lordship granted an interim injunction to restrain the defendants infringing the same patent, and his Lordship advised the person, who appeared and said he was the company, to make an end of the matter by agreeing to a perpetual injunction.

Mr. Justice Romer, on the same day, also had before him a motion by the plaintiff company for an injunction restraining the General Electric Engineering Co. from infringement of the plaintiff company's patent in connection with the half-watt lamp.

His Lordship granted the injunction asked for.

A South African Law Suit.

Some time ago, says our correspondent, the Salisbury (Rhodesia) Municipality called for tenders for certain alterations and additions to the power station. Tenders were received and the electrical engineer, Mr. C. H. Baskerville, and the architect reported in writing on them. Mr. J. M. Coull, a local ratepayer, was a tenderer, his tender being the lowest, but it was not accepted. Mr. Coull applied to the Town Clerk for an inspection of the engineer's and architect's reports. The Town Clerk refused and Mr. Coull then addressed a written request to the Town Clerk, who adhered to his attitude. The next step was an application to the High Court, and the judge granted an order for the production of the documents for Coull's inspection. The Municipality appealed to the Union Appellate Division.

The appeal was allowed, with costs, and the judgment altered to one dismissing Coull's application, with costs.

Marconi's Wireless Telegraph Co., Ltd., v. Mullard Radio Valve Co., Ltd.

In the Court of Appeal—consisting of the Master of the Rolls and Lords Justices Warrington and Younger—on February 5th, the hearing was concluded of the arguments in this case (*vide* our last week's issue). Judgment was reserved.

A Works Manager's Dismissal.

On February 2nd, at the Marylebone County Court, before Judge Scully, Mr. Charles O'Donnell, a works manager, sued Willesden Electric, Ltd., manufacturers, of Harlesden, for £53 13s. 4d. damages for alleged wrongful dismissal.

Plaintiff said that he was originally engaged by defendants as a works chemist at a salary of £250 per annum. In August last he was called to the office of Mr. Taylor (the managing director) who told him that the then works manager was ill and offered witness the position of works manager at £7 per week. Prior to coming into defendants' employ he had been experimenting in electric lamp manufacture, with good results. He had worked out a secret process. Mr. Taylor was told of the use of the process and later he demanded

to know what it was and prepared an agreement for witness to sign. Witness refused to sign it and he was then discharged with a month's salary. He now demanded three months' salary in lieu of notice.

The defendants' case, as given in evidence by Mr. Taylor, was that the plaintiff was engaged for the purpose of testing a photometer and filaments at a salary of £250 a year, and was a monthly servant. He was not satisfied with plaintiff's attitude and asked him to take the position of traveller, during which time the works manager became ill and witness asked him to take the works manager's position until his return or until other arrangements were made. He offered him a bonus in addition to the salary of £250. When the draft agreement was handed to plaintiff to sign he asked for time to consider the matter. He was discharged on the following day, not because he refused to sign, but because he had refused to obey an order telling him to discharge two employés.

Judge Scully, in giving judgment for the defendants, with costs, said he knew of agreements which stipulated that three months' notice had to be given on either side, but this did not govern cases in which there was no agreement. In the circumstances a month's notice was sufficient.

CORRESPONDENCE.

Letters received by us after 5 p.m. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

The Carelessness of Power Users.

I am greatly interested to see the letter of Mr. Pensabene-Perez in your issue of January 26th, regarding "The Carelessness of Power Users," in their selection of motors; while I heartily endorse his remarks, it seems to be a matter of opinion, whether it is not better from a maker's standpoint as regards selling and profit, to put cheapness of manufacture first, leaving efficiency to look after itself.

As a manufacturer of electrical machinery, I have for some years been "ploughing a lonely furrow" in advocating higher standards of performance in motors, as being by far the best proposition from the user's point of view.

In developing the range of machines with which my name is associated, my policy has been to strive after the highest possible performance figures consistent with reasonable cheapness of manufacture, feeling sure that the instructed user would appreciate that the saving in electricity charges would quickly compensate for any slight extra initial cost.

Since the recent trade depression, it has been found necessary to produce a cheaper line of motors to offer as an alternative to the high-efficiency type, since price appeared to be the only consideration when orders were being placed, and in almost every case, the cheaper and less efficient alternative has been chosen.

To show that this is a short-sighted policy, take the instance of, say, a 10-b.h.p., 3-phase, 50-cycle, 960 r.p.m., s.c.r. motor, running 48 hours per week, and 50 weeks per year on an average of ¾ full load.

The high-efficiency motor at to-day's price of £33 10s. has an efficiency of 90 per cent. on ¾ load, while the commercial type at £29 has an efficiency of 85 per cent., which is quite good for this size.

Taking the price of electricity at 1½d. per unit, the cost per year would be:—

High-efficiency type = 7.5 x 746 x 48 x 50 x 1.5/1,000 x .90 x 240 = £93.

Commercial type = 7.5 x 746 x 48 x 50 x 1.5/1,000 x .85 x 240 = £99.

It will be seen, therefore, that the user would save £6 per year for an extra initial outlay of £4 10s., which should appeal as a good investment to any business man.

Horace Green.
Horace Green & Co.

Cononley, Yorks.,
February 5th, 1923.

Arc Welding.

In answer to Mr. W. E. Rogers's letter in your issue of the 26th ult., I am delighted to read correspondence on any arcs, a.c. or d.c., especially if I can learn something.

I am not quite sure how far one may say that the arc is "struck" each half-period; I have suggested that a condition of what, for want of a better word, I called "continuity," exists, and must exist, in the arc space all the time, so that current, however little, can flow whenever there is any difference of potential. It has since been suggested to me that this state might be looked upon as a state of "ionisation."

As far as I am aware there is no wattless current due to the arc; the wattless current associated with a.c. welding is due to the regulating devices used.

Mr. J. F. Arnold has, I think, misunderstood me. My notes were on "The Welding Arc," not "Arc Welding," quite a different matter. I quite agree with what he says—so much so, that this is exactly what I should have written myself had he advocated one or other forms of electrode exclusively.

Further examples, and data, in which the use of either covered or bare electrodes has been found best, from the experience of any of your readers would, I am sure, be acceptable.

W. Langdon-Davies.

London, *February 3rd*, 1923.

Not Partnership—A Correction.

In your account of my evidence in the East Midlands Inquiry before the Electricity Commissioners, published in your current issue, page 170, you refer to me as "of the firm of Messrs. Rider & Wordingham." This misapprehension on your part has presumably arisen from Mr. Rider and myself having reported jointly on two occasions to the East Midland Conference of Local Authorities, but there is no connection between us of any kind, our respective practices being entirely independent of one another. I should be much obliged if you would be good enough effectually to correct this statement, which is liable to cause serious misunderstanding and to entail embarrassment on both of us.

C. H. Wordingham.

London, *February 5th*, 1923.

[We very much regret the error, which originated with our special reporter at the Inquiry, and was presumed to represent a statement made in the course of the proceedings.—Eds. Elec. Rev.]

Static Charge in Printing Machinery.

Replying to "Inquirer's" letter in your issue of Jan. 26th, if the proprietor of the paper works will run a wire connected to earth across the paper roll, but a few inches above it, and with several ends of bare wire attached to it, which should touch the paper when the latter is moving off the last roll, it will remove the static charge from the paper.

This is a common practice for removing the static charge from paper coming off a dry end paper-making machine.

E. Howlett.

Manchester, *February 2nd*, 1923.

A Motor-starting Problem.

I should be greatly obliged if any of your readers could offer a solution of the following problem:—

We have a number of circular saws driven by d.c., 460-volt motors operated on a 230/460-volt three-wire system. The motors and their control gear are all earthed in compliance with the Home Office regulations. Each separate motor is controlled by a local switch and starter and a double-pole circuit breaker on the main switchboard.

When an earth develops on the starter and the local switch is closed, the motor will commence to run immediately the circuit breaker on the main switchboard is closed. Should the operator be handling the stationary saw for any purpose a very nasty accident might be the result.

The machines would hardly be safe with an interlocked starter and switch, since the motor would start immediately the local switch was closed, whereas the operator would not expect the machine to run until the starter had been raised to the "on" position, and an accident might result.

My desire is to make these machines fool-proof and prevent the possibility of an accident occurring through the earth developing on the starter, and as I have not yet been able to apply a practical remedy for the fault I should be grateful for the co-operation of your readers.

E. Smith,
Electrical Engineer,
Whittaker Bros., Ltd.

Accrington,
February 1st, 1923.

The Sale of Wireless Apparatus.

I would like to second the remarks made by Mr. C. Culmer Hodges, A.M.I.E.E., in the current issue of your paper, *re* the sale of wireless apparatus, and I have no doubt there are many others who hold a similar opinion.

I would go one step further, and suggest that as the Broadcasting Co. are interested in the sales of wireless receiving sets, they should assist those endeavouring to sell such equipments by giving, say, one hour's demonstration each morning between 11 and 12 o'clock and each afternoon between 3 and 4 o'clock, so that intending purchasers could hear for themselves the actual results to be obtained from the sets offered for sale.

The New System Private Telephone Co., Ltd.,
H. G. Cowtan, *General Manager.*

London, *January 30th*, 1923.

BUSINESS NOTES.

Bankruptcy Proceedings.—Fuller Heath & Co. (Edward Fuller, Ernest Heath), electrical engineers, 26, Buckingham Gate, S.W.—Debtor attended on February 2nd before Mr. Registrar Francke, at the London Bankruptcy Court, for public examination upon accounts showing gross liabilities £4,560 (unsecured £2,875) and net assets valued at £80 after deducting £35 for payment of preferential claims. Replying to Mr. Vyvyan (Official Receiver) the debtor stated that in January, 1919, under the style of "Heath, Wingfield & Co.," he commenced the business of an electrical engineer at 110, Cannon Street House, E.C., removing in March, 1919, to 6, Hans Road, Brompton Road, S.W., where he continued it as "Heath, Wingfield and Co. (E. Heath, proprietor)" till March 20th, 1920, when, owing to losses incurred through bad debts, he executed a deed of assignment, under which dividends amounting to 5s. 7d. in the £ were paid on claims aggregating £6,695. He was subsequently without occupation until September, 1920, when, with about £300 capital, made by betting, he recommenced business at 26, Buckingham Gate, S.W., under the style of "Fuller Heath & Co." Since December, 1920, he had also carried on business as an auctioneer, but discontinued both business in April, 1921, owing to pressure by creditors. Witness attributed his present failure to insufficient capital, to a bad debt of £1,000, and to bad management on the part of a person, since deceased. At the rising of the Court the sitting was adjourned.

A. Satterthwaite (Gregson & Co.), electrical engineer, 22, Dutton Street, Liverpool.—Receiving order made February 1st on debtor's own petition.

F. Raybould, electrical engineer, 48, King Street, Darlaston.—Receiving order made January 30th on debtor's own petition.

Company Liquidations.—The Projector Publicity Co., Ltd., 11, Denman Street, Piccadilly Circus, W.—This company was formed in December, 1921, with a nominal capital of £500, in £1 shares, to carry on business as merchants and dealers in all kinds of electrical fittings and devices, electric novelties for advertising, and for other purposes. A winding-up order was made against the company last June, and on January 31st the statutory first meetings of the creditors and shareholders were held at the Carey Street offices of the Board of Trade, Lincoln's Inn, W.C. Accounts were submitted, showing debts £315, assets valued at £181, and a deficiency of £634 with regard to contributories. In the absence of voting quorums, the meetings were formally adjourned for a week, it being understood that the liquidation would then be left in the hands of the Official Receiver.

The Associated Electric Traders, Ltd., 2, Percy Street, Tottenham Court Road, W.—The creditors and shareholders of this company (in liquidation) met on February 1st, at the Board of Trade Offices, Carey Street, W.C., before Mr. G. D. Pepys, Official Receiver. The compulsory winding-up order was made on the petition of Messrs. Cox & Co., bankers, Charing Cross. The chairman reported that the company was registered as a private company on September 7th, 1920, with a nominal capital of £10,000, divided into 3,000 10 per cent. cumulative preference shares of £1 each and 7,000 ordinary shares of the same amount. It was formed to acquire a business which had been carried on by Mr. John Leitch under the style of the British Electric Trading Co., also to carry on business as wholesale and retail importers, exporters and dealers in alabaster bowls, figures, and electric fittings. The directors were Mr. L. C. Russell, who was appointed governing director at a fee of £1,000 per annum; Mr. A. F. Phelp (resigned May, 1921); Mr. J. R. Williams, (resigned February, 1922), and Mr. C. P. Wenzel, who in May, 1922, was made a permanent director and was accorded the same powers as were held by Mr. Russell. The qualification of a director was the holding of 25 shares, and all the directors were duly qualified. Mr. Russell had stated that the business of the British Electric Trading Co. had been carried on by his step-son (Mr. John Leitch) for eighteen months before it was taken over by this company, and during that period a small net profit was made. There was no formal sale agreement with the company, but in a balance sheet of July 31st, 1920, the assets were valued at £7,087, and the liabilities were returned at £2,553. It was impossible to state the consideration given by the company for the purchase of the business, nor the date it was actually taken over, but from a balance sheet dated June 30th, 1921, it appeared to have been taken over as from March 1st, 1920. In the balance sheet there was an item of assets "Prepared charges under agreement apportionable later, £2,000"; that apparently represented the benefit of a profit of about £2,000 shown by the accounts on July 31st, 1920, and for which Mr. Russell was to receive £2,000 ordinary shares of the company. The issued capital was 4,827 ordinary and 650 preference shares. Mr. Russell had stated that so far as he could ascertain, all shares were paid for in cash, but Mr. Williams, a late director, had asserted that he received 2,775 £1 shares, fully paid, as nominee for Mr. Russell, presumably as part of the purchase price of the business acquired. Mr. Russell seemed to have had two or three separate accounts in the books of the company, including a private account and a loan account, but having regard to the imperfect manner in which these accounts had been kept, it was impossible to say what they represented or what was the true state of affairs. In the statement of affairs, Mr. Russell returned himself as a creditor of the company for £1,921. On May 22nd, 1922, the capital of the company was increased to £30,000, by the creation of 20,000 ordinary shares which were allotted fully-paid, as follows:—10,000 to Mr. Russell in consideration of his transferring a one-half share of the Marylebone Electric Fittings Co., and 10,000 to Mr. Wenzel in consideration of his handing over certain foreign agencies and connections. Then on May 22nd, 1922, 25 debentures of £100 each were sealed and issued to Mrs. M. Wenzel; they were secured by the assets of the company and were in consideration of a cheque given the same day to enable the company to extend its business. The bonds, however, were not delivered to the Registrar of Joint Stock Companies within the statutory period of 21 days, and according to a memorandum in the minute book of July 4th, 1922, new debentures were that day sealed and issued to Mrs. Wenzel and they were registered on July 14th, 1922. As the latter bonds were given for a past consideration, the money having been paid in May, and as they were given within three months of the presentation of the petition for winding up, their validity would be contested. It further appeared that the allotment of the 20,000 shares to Russell and Wenzel was not completed. A debenture action was commenced by Mrs. Wenzel to enforce her security, and on September 20th, 1922, Mr. T. J. Wilson, C.A., 59-60, Old Bailey, E.C., was appointed receiver and manager. That gentleman had, with the sanction of the Court, entered into an agreement for the sale of the company's lease for £100, and the stock at a valuation of about £500. He had collected some of the book debts, and had altogether in hand about £900, which would be available towards meeting the debenture holder's claim of £2,500, if it were held to be a valid claim. That £900 was all that was expected to be obtained for the assets, although in the statement of affairs they were returned at £4,042, an obviously misleading figure. In the event of the debentures being disallowed, the £2,500 would be added to the unsecured debts of £5,719, and the £900 from the assets would be available for a dividend on the total amount of liabilities, *viz.*, £8,219. The failure of the company was attributed by Mr. Russell to depreciation in the value of the stock and the general fall in prices in the trade. Three accountants were nominated for the post of liquidator, but in the end, a resolution was passed for the liquidation to be left in the hands of the Official Receiver.

Corona Lamp Works, Ltd., 10, Ascham Street, Kentish Town, London, N.W.—Under a compulsory winding-up order made against this company in June, 1922, the statutory first meetings of creditors and shareholders were held on Tuesday at Carey Street. The accounts showed total liabilities £110,655 (assets valued at £27,251, but absorbed by the claims of debenture-holders), and a deficiency of £84,265. Our detailed report of the proceedings will appear next week. It was decided to leave the liquidation in the hands of the Official Receiver. The following are the principal creditors:—

	£		£
Bell & Co.	676	Ogilvie, A.	6,666
Crystal Glass Co.	21	Ogilvie, G. N.	1,666
Humphries, Horham, Ltd. ...	37	L.C.W. & Parr's Bank ...	3,059
Livingstone Bros.	18	Aeronautical Inst. Co., Ltd. ...	9,204
Stephenson & Sons, Ltd. ...	21	Vactite Wire Co., Ltd. (1919)	59
Wilkinson, Ltd.	27	Smart, H. W.	1,591
Hazell, J. J.	66	British Thomson-Houston Co.,	
Public Trustee	120	Ltd.	5,590
Johnston & Co.	58	Sutherland & Partners ...	4,180
Metallic Electrical Eng. Co. ...	11	FULLY SECURED.	
Macram, Ltd.	49	Portman Chapel Building	
Ogilvie, G. N.	14,163	Society	1,139
Ogilvie, A.	3,621		

Portable Electric Motors (1919), Ltd.—Liquidator, Mr. H. E. Burgess, Senior Official Receiver, Carey Street, W.C., released January 31st.

Engineering Products Co., Ltd.—A petition for the winding-up has been presented to the High Court by A. W. Wall, Ltd., general engineers, King's Road, Tyseley, Birmingham, creditors, and will be heard in London on February 20th.

Anode Wireless & Scientific Instruments, Ltd.—Winding up voluntarily. Liquidator: Mr. E. S. Howard, 26, Budge Row, E.C. A meeting of creditors was called for February 9th.

British Illuminated Sign Co.—Winding up voluntarily Liquidator, Mr. R. Stephens, 31, Lombard Street, E.C.; meeting of creditors, February 14th. Particulars of claims to be sent to the liquidator by February 28th.

E.B.C. Electrical Co., Ltd.—Winding up voluntarily. Liquidator, Mr. F. Rowland, 3, Thames House, Queen Street, E.C.

Catalogues and Lists.—Messrs. L. G. Hawkins & Co., Ltd., 116, Charing Cross Road, W.C.2.—An illustrated leaflet and a poster announcing the gift of a "Universal" table stove with each "2701" "Miller" lamp sold.

Messrs. Gyer, Hill & Gyer, 661-3, Harrow Road, Willesden, N.W.10.—An illustrated and priced sheet of tools, &c.—Government surplus stock.

The Cable Accessories Co., Ltd., Tividale, Tipton, Staffs.—A priced and illustrated pamphlet describing the "Revophone" crystal receiving set for "broadcasting."

Mr. Harry Moss, 82, Leeds Road, Bradford.—A series of postcards illustrating buildings in which electrical installations have been executed.

The New Italian Art Association, Ltd., 38, Newman Street, Oxford Street, W.1.—An illustrated leaflet advertising alabaster bowls with cord suspensions. Priced.

Igranic Electric Co., Ltd., 147, Queen Victoria Street, E.C.4.—Leaflets Nos. 2,226, dealing with coil holders for radio work; 2,236, describing audio frequency intervalve transformers; and 2,241, illustrating and describing filament rheostats.

Messrs. Crowther & Osborn, Ltd., 7, Blackfriars Street, Salford, Manchester.—A price list of "Sceando" drawn-wire lamps of various types.

Messrs. Joseph Adamson & Co., Hyde, Cheshire.—An illustrated pamphlet dealing with the durability of electric cranes.

The Mirrlees Watson Co., Ltd., Scotland Street, Glasgow.—Pamphlets Nos. Pu. 600, illustrating and describing a high-vacuum extractor pump for condensers; and Pu. 750, dealing with high-lift turbine pumps—multiple ring and barrel casing types.

Messrs. A. C. Alexandra & Co., 10, Iddlesleigh House, Caxton Street, Westminster, S.W.1.—An illustrated price list of a.c. and d.c. motors, and d.c. generators.

Mr. F. Lake, 44-47, Devonshire Street, Theobald's Road, London, W.C.1.—Price list of job electric cable in stock.

Messrs. Drake & Gorham Wholesale, Ltd., 67, Long Acre, W.C.2.—January catalogue (No. 368) of electric lighting fittings, including a wide range of pendants, bowls, shades, switch plates, &c. Fully illustrated and priced.

Simplex Conduits, Ltd, Garrison Lane, Birmingham.—An illustrated booklet dealing with the "Durex" wiring system for electric light and power installations.

The Relay Automatic Telephone Co., Ltd., Marconi House, Strand, W.C.2.—An illustrated brochure describing the apparatus at the Fleetwood automatic exchange, published as a souvenir of the opening of the exchange.

The Cambridge & Paul Instrument Co., Ltd., 45, Grosvenor Place, S.W.1.—A folder illustrating a number of instruments, draught gauges, calorimeters, pressure recorders, &c., for use in power stations.

Centrifugal Clutches, Ltd., 32, John William Street, Huddersfield.—A leaflet describing the "C.C.L." centrifugal clutch.

Trade Announcements.—The manufactures of Messrs. Brook, Hirst & Co., Ltd., of Northgate Electrical Works, Chester, having been for some time past identified by the name of "Brookhirst Switchgear," the company has now decided to proceed a step further and to trade in future under the title of "Brookhirst Switchgear, Limited." The change became effective on February 1st, and all accounts owing to or by the concern under the former name are to be settled by Brookhirst Switchgear, Ltd. The change of name involves no alteration in established policy, or in the *personnel* of the board and administrative staff, or in the branch offices and agents. In announcing the change to the trade, the company gives particulars of developments that have taken place in the design and production of its manufactures, and states that complete catalogues are in course of preparation. The scope of manufactures has been so extended as to include not merely hand-operated and automatic motor starting panels for direct current, but also a complete range of oil-immersed alternating-current switchgear. In addition, considerable attention has been given to motor control gear for use aboard ship, and special types have been designed to meet the requirements of the Admiralty.

Messrs. Holmes & James, Ltd., have taken larger premises at Excelsior Works, Ellis Street, Birmingham, to deal with increased business. Telephone No.: "Midland 574"; telegrams: "Infinity, Birmingham."

Mr. George Wright is commencing business at The Bungalow, St. Ives, Ringwood, Hants., with a branch at 33, Palmerston Road, Boscombe, and desires to receive catalogues, &c.

Messrs. A. C. Alexandra & Co., 10, Iddesleigh House, Caxton Street, Westminster, S.W.1, have been appointed selling agents for Messrs. Howells' (Stafford) motors.

Messrs. Austin Walters & Son, Manchester, have disposed of the armature repair portion of their business to Messrs. Pearn, Grey & Armstrong, Ltd., Hewitt Street, Knott Mill, Manchester.

In future Mr. John E. Fowler will carry on alone the business of Gilrain & Fowler, electric light and power engineers, of 12, Grove Road, Wakefield.

Messrs. Bartlam & Son, of Torquay and Selby, have taken over the business of W. Hunt & Son, electricians and lighting engineers, of 35 and 36, High Street, Barnstaple.

The electrical and general engineering business of Messrs. Champ, Kay & Co., of Warwick, has been taken over and absorbed into the business of the Eagle Engineering Co., Ltd., and will form the nucleus of an electrical and wireless department.

Messrs. Cleworth, Wheal & Co., Ltd., of Castleton, near Manchester, have appointed Messrs. Dektereff, Francke and Reppman, of 118, Queen Victoria Street, London, E.C.4, as their new representatives for the London area.

Mr. R. Ferguson Brown, carrying on business as R. F. Brown, electrical engineer, at 10, Mains Street, Glasgow, has retired from that business, and it has been purchased by Messrs. Walter Bennett, Ltd., who will carry on at the same address under the name Walter Bennett, Ltd. Mr. Brown will attend to debts, &c. Messrs. Bennett desire to receive catalogues.

Radio Instruments, Ltd., of 12, Hyde Street, New Oxford Street, W.C.1, has taken over the lease of buildings adjacent to its present works to meet increased demands for its wireless instruments.

Mr. J. Bedford, who is commencing business as the Bedfordshire Electrical Installation Co., at 89, Coventry Road, Bedford, desires to receive catalogues and price lists.

Ryland's Electrical Co. has opened new showroom premises at York House, Goodmayes Road, Ilford.

Australian Steel Works to Reopen.—It is announced that the Broken Hill Co.'s steel works at Newcastle, New South Wales, will resume operations shortly.—*Reuter* (Melbourne).

Book Notices.—"Corrosion as Affecting the Metals Used in the Mechanical Arts," by Dr. W. H. Hatfield (Brown-Firth Research Laboratories). Reprinted from *The Engineer*.—This paper was read in December before the Sheffield Association of Metallurgists and Metallurgical Chemists. It includes, among other matters, the results of experiments carried out to determine the relative resistance of typical industrial metals to various corroding agents. Twenty-one materials, ferrous and non-ferrous, were treated, and these are analysed, their mechanical properties are stated, and the results of acid, corrosive, and electrolytic tests are tabulated. One page of the paper is devoted to photo-micrographs of the samples tested.

"*The Electric Railway and Tramway Journal* Diary, 1923," takes the form of a replica of the usual issue, with the addition of a double-column diary interleaved with blotting paper. The matter preceding the diary includes postal and telegraphic information and articles on mercury vapour rectifiers, automatic sub-stations, the electrification of light railways, and a Government Committee's report upon the transfer of the duties of the Light Railway Commissioners to the Ministry of Transport. Following the diary is a directory section, containing details of personnel of British electricity works, tramway systems, &c., and other useful information.

The *Transactions* of the South African Institute of Electrical Engineers. November, 1922. Johannesburg: The Institute. Price 2s.—Practically the whole of this issue is devoted to a paper on "The Manufacture of Calcium Carbide and Electrodes in the Transvaal," by W. Elsdon-Dew, M.I.C.E., M.I.E.E., and W. Alderson, M.I.E.E. A meeting of the Wireless Section is reported.

Messrs. Crosby, Lockwood & Sons have issued their quarterly list of new publications, which includes a number of works on electrical engineering and kindred subjects.

"Pitman's Radio Year Book, 1923." London: Sir Isaac Pitman & Sons, Ltd. Price 1s. 6d. net.—This is the first issue of the year book, which makes its appearance at an opportune moment. It is divided into three sections, containing respectively general information and official data, articles by experts, and a directory of manufacturers of radio apparatus. A list of wireless societies is given, and particulars of transmitting stations of special interest to amateurs are tabulated, together with data regarding weather reports and time signals. The numerous technical articles are contributed by authors of established reputation in connection with wireless communication, and include items of interest for everyone. A glossary is provided for the use of the non-expert reader. Altogether the year book does credit to its producers, and will be of great service to the growing army of radio experimenters.

"British Standard Glossary of Aeronautical Terms" (Specification No. 185—1923 of the British Engineering Standards Association). London: Crosby, Lockwood & Son (for the Association). Price 1s. net, 1s. 5d. post free.—This is a useful technical guide to the terminology peculiar to aeronautics in its several branches.

"Mathematics for Engineers," by W. N. Rose. Part II, second edition. Pp. ix+423; 143 figs. London: Chapman and Hall. Price 13s. 6d. net. The second edition of this section of the "D.U." series varies only slightly from the original one. A number of corrections have been made, a few exercises have been added, and the work on "least squares" has been made more complete by the inclusion of a section relating to the determination of laws.

The *Metropolitan-Vickers Gazette* for December, 1922, contains illustrated articles on "Electric Drive for Strip and Hoop Mills"; "High-voltage Cable Power Transmission," by G. E. Gittens, B.Sc.; the South African railways, &c.

"Handbook for Electrical Engineers," by Harold Pender. Second edition. Revised and enlarged. Pp. xiii+2,263. Price 30s. net. "Direct-current Machinery," by H. Pender. Pp. x+314; 146 figs. Price 15s. net. London: Chapman & Hall, Ltd.

"Papers on Internal Combustion Engines," read and discussed at the Institute of Marine Engineers. London: The Institute. Price 12s. 6d.

"Science Abstracts" (A. and B.), Vol. XXVI, Part I, No. 301. Price 3s. each. Also Indexes to Vol. XXV (A. and B.), Price 2s. 6d. each net. London: E. & F. N. Spon, Ltd.

Sir Isaac Pitman & Sons, Ltd., have commenced the issue of a new work of a popular nature entitled "Business Building," which is to be completed in 26 fortnightly parts (1s. net each). The series will cover a wide field in the commercial and industrial world. The first number contains articles on "Business Premises," by Dr. R. W. Holland, O.B.E.; "The Lighting of Shops, Offices, Warehouses, and Factories," by J. S. Dow; and "Industrial Heating and Ventilating," by John D. Troup, M.I.Mech.E. The work is profusely illustrated. Future numbers will deal with accountancy, organisation, staff selection, secretarial work, foreign exchange, insurance, and a host of other subjects which come within the scope of such a production.

All concerned in the production of the first number of *Modern Wireless* are to be congratulated on the result of their efforts. To the already large and enthusiastic body of experimentalists this new illustrated monthly, published by Radio Press, Ltd., one of the two publishing firms exclusively concerned with radio science, should appeal especially, being well printed on good-class paper, and containing, in addition to a number of excellent articles, several features which will be of use for reference purposes in the future. This latest addition to the rapidly-growing crop of periodicals devoted to radio matters has a wide scope; the responsibility of editorship has been entrusted to a professional radio engineer rather than a journalist, and the name of Mr. John Scott-Taggart, with Prof. G. W. O. Howe as scientific adviser, will inspire confidence in the technical accuracy of the journal.

Australian Lead Smelters Stopped.—In consequence of a Belgian firm outbidding for the Ajada lead mine's output of 300 tons monthly the Fremantle Trading Co. has been compelled to close its smelters. Owing to this decision 160 hands are rendered idle.—*Reuter's Trade Service* (Perth).

America and Norwegian Aluminium Works.—According to reports from Christiania the Aluminium Co., of America, is participating to the extent of one half in the share capital of a new company which is being formed to develop the production of aluminium and its manufactures in Norway. The other half is being subscribed by the Hoyang Falls Co., which owns the hydro-electric works of that name and the aluminium works at Hoyang Falls, together with works, through a subsidiary company, at Holmstrand for the production of manufactures of aluminium. The hydro-electric works will remain the property of the Hoyang Falls Co., and will be developed to 50,000 h.p., while the new company will take over the aluminium producing works for extensions and obtain a supply of power from the former.

Underfeed Stoker Contracts.—Among important contracts recently obtained by the Underfeed Stoker Co., Ltd., are the following:—

Hong Kong Electric Light Co., two travelling grates and ash conveyor; Victorian State Electricity Commission, Melbourne, 36 travelling grates; Brighton, two travelling grates; Watford, four travelling grates; Nottingham, ash conveyor; Gouda Electricity Works, Holland, one travelling grate; and the Nankai Electric Light Co., Japan, two travelling grates.

Scottish Electricians' Wages.—The dispute between employers and employés in the Scottish electricity supply industry has been settled, the unions having agreed to a compromise whereby wages will be reduced in three stages: 5 per cent. on February 1st, 2½ per cent. on May 1st, and 2½ per cent. on August 1st. The reduction is equal to a loss of 6s. as compared with the original proposal for 12s. There will be no further revision until January, 1924. Over 5,000 workers in municipal and private undertakings are affected.

Trade with Java.—The British Commercial Agent for the Netherlands East Indies has forwarded to the Department of Overseas Trade a review of the general commercial activity of Djokjakarta, or Djokja, the sixth largest town in Java. He says that in machinery and accessories the principal requirements are sugar machinery, rice mills, electrical goods, boilers, pumps, water pipes and fittings, agricultural implements and hand tools, and chemical manures, principally ammonium sulphate. The trade is shared by the United Kingdom, Germany, Holland and the United States, and there is nothing to indicate that any one of the competing countries has established a monopoly. In the last twelve months, Germany has obtained a strong hold on the accessories trade, in particular, water pipes and fittings and hand tools.

Lead.—In their report dated February 3rd, Messrs. James Forster & Co. state:—"Consumers have been very scarce as buyers lately, which is not to be wondered at after the mad advance of last week. Yesterday, however, business was done for London works. Imports for January from the Customs entries, for London and Liverpool only, total 13,622 tons, which means probably over 16,000 tons for the whole country, a figure not indicative of any scarcity. The enormous speculative account open on the Metal Exchange dominates the position, supply and demand of actual metal being relatively unimportant. . . . Lead at £40 in America will re-open the poor grade mines closed since the war, and present prices in Europe must conduce to increased supply."

Wax Candles for Electric Light.—Although the wisdom of the retention of the candle form of illumination with electric lighting may be open to question, there is no doubt a demand for it. The material usually employed for this purpose is porcelain or of a vitreous nature, but the Wax Electric Light Tube Manufacturing Co., Ltd., 1, Queensborough Passage, Lancaster Gate, W.2, has reverted to the original. The products of this company consist of wax tubes having internal aluminium tubes for slipping over the standards of "candle" lamps—or apparently the lampholder can be fitted in the top of the tube and the leads brought up to it. The wax employed is produced in thirty different shades and tints, and it is claimed that any scheme of decoration or furnishing can be suited. The melting point of the wax is 170 deg. F., a very safe limit.

Local Exhibitions.—Edinburgh.—Electricity for heating, lighting and cooking, and in connection with many labour-saving devices, claims the largest share of attention at the Ideal Homes Exhibition, now running in Edinburgh. The Electrical Contractors' Association of Scotland has a large stand, at which a complete range of everything electrical for the home is to be seen. The exhibits include a fine display of lighting fittings suitable for all classes of houses. There is also a large variety of electric fires. The contractors exhibit a semi-automatic generating set, made by Messrs. Armstrong, Whitworth & Co. and Crompton and Co. Continuous radio demonstrations are given by Messrs. Spensers (Scotland), Ltd., Edinburgh. The Edinburgh Corporation Electricity Department shows a fine assortment of labour-saving machines.

Messrs. Robert Adams & Son, Ltd., show radio sets and domestic appliances, and there are numerous examples of well-known manufacturers' products, including "Falco" and "Hotpoint" appliances.

Technical Advertising.—In a recent issue of the *S.A. Engineer and Electrical Review* a number of hints on the correct advertising of engineering products appeared. The writer pointed out the essential difference between advertising in the lay Press and technical journals; in the former case the general public was reached, but in the latter the advertisements were read by persons who possessed expert knowledge and knew what they required. Therefore it was of no use making exaggerated or broad claims; definite information only should be given. As examples of the two methods, the following were given:—

"Blank's Extra Refined and Warranted Best Cast Steels are the most Uniform and Reliable for tools and dies, &c."

"The number of crescent-shape Ford Timer contacts per die was increased to 125,000 through use of this Blank Die. This was 215 per cent. greater than obtained with a high-speed steel die previously used. The stock is 5/16-in. steel."

The first advertisement made a claim which was not substantiated by any facts, while the other gave a definite indication of value. Clichés, empty meaningless expressions, should be avoided; they were easy to use, but meant very little. The engineering advertiser should not give his *own* opinion of his product, for to the mind of the buyer this was obviously prejudiced and carried no weight. The reader wanted a clear and accurate statement, backed up, if possible, with facts and figures. Actual details of performance should be given.

Another point dealt with was the discriminating between different markets. Advertisements which appealed to Great Britain might not have the same effect in China. The Americans realised this fully, but British advertisers often ignored it. Illustrations were criticised; it was considered that these should be clear and should show either the quantity of work done, the quality of the work, or, best of all, the machine doing the work. The allegorical or symbolical method should be carefully and sparingly employed. The custom of illustrating works was thought to be of doubtful utility.

Public Contracts and Unemployment.—With reference to our leaderette (January 26th, p. 123) in which we directed attention to the important communication addressed to the Prime Minister by the Federation of British Industries, we have received from Mr. G. Wüthrich, of Messrs. Oerlikon, Ltd., a copy of a statement that had been issued by him, in reply to articles which had appeared in various publications, with the object of demonstrating that "orders going to Switzerland cannot be compared with orders placed with low-currency countries, and that Great Britain's position as an exporting country is best secured by assisting Switzerland's industries and thereby enabling Swiss manufacturers to place orders with British manufacturers and producers."

Scheme of Arrangement.—Twiss Electric Transmission, Ltd.—By order of the High Court a meeting of shareholders will be held at 39, Victoria Street, S.W., on February 21st, for the purpose of considering, and if thought fit, approving a scheme of arrangement proposed to be made; a copy of the scheme can be seen at the registered offices of the company.

New Belgian Company.—A new company has just been formed in Brussels, with a capital of 1,000,000 fr. and the title La Société de l'Usine Belge de Matériel Electrique, Vynckler, Frères & Cie., to acquire and carry on the Vynkler electrical engineering business at Schaerbeek, Brussels.

Why the Negotiations Failed.—A fortnight ago we expressed our surprise and regret that the Industrial League and the National Alliance had failed to come to agreement with regard to amalgamation. We asked for details of the constitutional differences which had led to failure, and these have now been provided by the Secretary of the Industrial League and Council in the form of a statement which sets out the history of the negotiations. The joint committee which sat to consider the matter at the end of November proposed the following clause as part of Resolution 2. By the side of this clause which the National Alliance representatives said their Executive Committee could not agree to, we print one that the Alliance suggested in its place. The differences are italicised by us:—

Joint Committee Clause.	The National Alliance Suggestion.
"That this draft Constitution shall *aim at* the establishment of a General Council and an Executive Committee on the basis that the members of such Council and Committee shall be *as to two-thirds representative of Employers' Associations and Trade Unions, and the remaining one-third to be composed of individuals in* sympathy with the aims and objects of the new body, such General Council and Executive Committee to be equally representative of employers and employed."	"That this draft Constitution shall *provide for* the establishment of a General Council and an Executive Committee on the basis that the members of such Council and Committee shall be as to 40 *per cent. representatives of Area Federations, as to* 40 *per cent. direct representatives of Employers' Associations and Trade Unions, and as to* 20 *per cent. individuals in* sympathy with the aims and objects of the new body, such General Council and Executive Committee to be equally representative of employers and employed."

The official notes before us state that the Industrial League representatives were willing to leave the constitution of the new body entirely in the hands of the proposed Provisional Executive Committee after amalgamation, but were not willing to accept the definite constitution as put forward by the National Alliance.

The Executive of the Industrial League and Council states that it desires to record its disappointment that the negotiations should again have broken down, particularly after the complete and comprehensive agreement reached by the first Joint Committee of the accredited representatives of both sides. "That agreement seemed to clinch the matter, and it was accepted by the Industrial League and Council, which was content to leave all questions of policy and constitution to be settled by the new joint body. The National Alliance of Employers and Employed, however, refused to endorse the joint recommendations unanimously carried by the selected representatives of both bodies and sought to commit the new body to a definite acceptance of a constitution on the lines of its own. The Executive Committee of the Industrial League and Council holds that it was impossible and undesirable to seek to tie the hands of the new body in this way or to commit it to any particular plank in the programme of either of the existing bodies.

"The Executive Committee takes this opportunity of stating that it is not in any way opposed to the principles of representation by association. . . . But it also recognises that in many cases representation by association is an utter impossibility, and that to seek to insist upon it is to limit the usefulness of its work."

New Metropolitan-Vickers Showrooms.—The Metropolitan-Vickers Electrical Co., Ltd., has opened this week new showrooms at No. 14, Long Millgate, Manchester. At these premises a large display of electric lighting fittings has been brought together. These are chiefly of ornamental brass, produced by the firm's associates, Messrs. Harcourts, Ltd., of Birmingham. There are also fittings of a plainer type, and a special room in which wiring materials of many kinds are displayed. One room has been equipped as an electric kitchen, and it is intended to give cooking demonstrations, using "Cosmos" appliances.

In addition to the above radio-telephony receiving apparatus is on view and the broadcast concerts, &c., are reproduced for the benefit of visitors.

Reactance Radio Sets.—Messrs. Rogers, Foster & Howell, Edward Road, Birmingham, announce that they have now perfected two-, three-, and four-valve receivers containing reactance, but conforming in every respect with the regulations of the ordinary broadcasting licence. As an example of the advantages possessed by the new reactance set, it is stated that in the makers' testing laboratory, which is situated within three miles of the Birmingham broadcasting station, it is possible to "tune out" the latter when it is in full operation, and to receive either London, Manchester, to say nothing of Paris, or the Hague concerts, at maximum strength, without loss of volume or distortion. The importance of this will be appreciated by anyone who has hitherto been using an ordinary receiver within a few miles of a high-power broadcasting station, and who knows the difficulty there has been in the past in cutting out the local station to concentrate upon another more distant concert.

The Coin in the Container.—We seem to have heard the story before, or one like it at any rate. But it is worth repetition if only as a reminder of the intensive and unscrupulous methods employed by the Germans in their fierce competition for export trade. The tale concerns a consignment of dyes which was captured during the war and found its way to Spain. There it was reported to the purchaser that a Chinese coin had been discovered at the bottom of each tin. Here was a puzzle. Why should Chinese coins be found in packages of German dyes? The question was discussed at the British Chamber of Commerce in Spain, and after inquiry, it was elicited that the consignment was originally ordered by a Shanghai firm. Had it arrived at its real destination, the coins would have reached the hands of Chinese workmen, who, according to the calculations of the wily Teuton, would have lost no time in getting to the bottom of the remaining tins, pocketing the "douceur" and asking for more of the same kind.

In this story we have another example of the muddled mentality which characterised German behaviour before and during the war. No British manufacturer would expect to make a successful appeal for permanent custom by such underhand methods. Yet the British exporter might be well advised to take the warning offered by the Chamber of Commerce and seek for anything of a hidden nature by which the Germans may be frustrating his best efforts. It is doubtful whether, for a long time to come, the Germans will find it profitable to play the trick of the coin in the container. They will be unable much longer to exchange their marks for Chinese copper "cash."

"D.P." Battery Contracts.—The "D.P." Battery Co., Ltd., has in hand at the present time two batteries of 2,818-Ah capacity (ultimate capacity 4,933 Ah for Minories Exchange, London, and also four batteries of over 1,000-Ah capacity each for Newport, Mon.

Calendar.—Messrs. Belling & Co., of Derby Road Works, Edmonton, N.18.—We have received a neat wall calendar with monthly slips, each of which bears an illustration of a Belling fire or other domestic appliance.

For Sale.—Fulham B.C. Electricity Department has for disposal a surface condensing plant, complete with Edwards air pump; Great Western Railway Co. Stores Department invites offers for a surplus generating set; by direction of the Disposal Board Messrs. Oliver, Appleton & Kitchen will sell by auction, on February 20th and following days, at C.S.D., No. 85, Barnbow, near Leeds, machine tools, engines, boilers, electric motors, electrical stores, accumulators, switchboards, &c. (See our advertisement pages to-day.)

Tyneside Colliery Developments.—The Wallsend and Hebburn Coal Co., which has pits at each side of the Tyne, is about to launch an important scheme of development. The company intends to sink a new shaft at Monkton, near Jarrow; and also to construct new coal shipping staiths on the river at Hebburn Colliery. The contract for the erection of the staiths has been placed with Messrs. F. Turnbull & Co., Heaton Junction, Newcastle-on-Tyne, and the consulting engineers are Messrs. J. Watt Sandeman & Son, Newcastle. Electrical plant will be used throughout, and the motors are to be supplied by the Metropolitan-Vickers Electrical Co., Ltd., Manchester. The new shaft is also to be worked electrically, and a special winder will be installed, the gearing for which will be supplied by Messrs. Robey & Co., of Lincoln, while the Metropolitan-Vickers Electrical Co., Ltd., will supply the electrical plant. At the Edward Pit, Wallsend, which is completely worked by electrical plant, it has been decided to install a new winder with a view to increased output.

Applications for British Trade Marks.—Below we give a summary of the recent applications for British trade marks in respect of goods and productions connected with the electrical trades and industries. Individuals and firms desiring to enter an objection to any of the applications have one month in which to do so from the dates given below. In the case of foreign applications the names and addresses of the British representatives to whom the objections are to be sent are also given:—

Elmo. No. 430,025. All goods in Class 6. No. 430,026. All goods in Class 7. Siemens-Schuckert Werke Gesellschaft, Siemensstadt, Berlin. (Haseltine, Lake & Co., 28, Southampton Buildings, Chancery Lane, London, W.C.) January 31st, 1923.

Idonite. No. 430,066. All goods in Class 8. Bakelite Gesellschaft, 32, Lutzowstrasse, Berlin, W. (Dicker & Pollak, 20-23, Holborn, London, E.C.) January 31st, 1923.

Brumite. No. 431,485. Class 8. Electric cables. The Craigpark Electric Cable Co., Ltd., 210, Flemington Road, Springburn, Glasgow. January 31st, 1923.

Lyrian. No. 431,632. Class 8. Apparatus for use in wireless telegraphy and telephony. Radio Instruments, Ltd., 12, Hyde Street, New Oxford Street, London, W. January 31st, 1923.

Alpha. No. 430,378. Class 13. Electric lamps for automobile vehicles. Arthur C. Alexandra, trading as A. C. Alexandra & Co., 10, Iddesleigh House, Caxton Street, Westminster, S.W. January 31st, 1923.

Ferro-Arc. No. 431,910. Class 13. Electrodes of ordinary metal for electric welding. The Ferro-Arc Welding Co., Ltd., 12, Grosvenor Gardens, London, S.W. January 31st, 1923.

Correction.—We regret to find that through a printer's error in the advertisement of the Edison & Swan Electric Co., Ltd., appearing on page 30 of our last issue, the word "Edison" was used instead of "Ediswan" in the first line of letter-press.

E.C.A. : A Sub-Branch at Croydon.—On January 31st a meeting of the electrical contractors of Croydon was held at the Greyhound Hotel, when officials from the Central Office of the Electrical Contractors' Association (Inc.) were present. A sub-branch of the Association was formed, comprising electrical contractors in the Croydon area. Mr. A. D. Dean was elected chairman, and his son, Mr. J. A. Dean, hon. secretary. Meetings are to be held on the last Wednesday in every month.

Patent Application.—Application has been made for the restoration of Patents No. 148,380 and No. 174,064, both of July, 1916, granted to Albert Van Tuyl Day, for "Improvements in or relating to Electric High-Frequency Signalling."

Australian Tariff Alterations.—The deferred duties on aeroplanes and aircraft and metal cordage, except aluminium cable, will not be brought into operation in Australia until June 30th next, nor on paper-insulated, lead-covered telegraph and telephone cables till March 31st.—*Reuter's Trade Service* (Melbourne).

LIGHTING AND POWER NOTES.

Aberayron.—Electricity Charges.—Under the Electric Lighting Order granted to Mrs. E. G. Richards, the maximum price to be charged for electricity has been fixed at 10d. per kWh instead of 1s. 1d. as originally intended.

Abertillery.—Loan Sanctioned.—The Urban Council has received sanction from the Electricity Commissioners to a loan of £10,340 for plant, &c., for the electricity scheme.

Andover.—Electricity Supply.—The War Office has informed the Town Council that electricity from the power station at Tidworth, in conjunction with the Andover Aerodrome, cannot be supplied to the Corporation. With reference to the Electric Lighting Order, granted in 1915 to Crompton and Co., Ltd., and now held by the Andover Electric Light and Power Co., Ltd., an extension of time for commencing the works has been granted until March next, and an application has been made to the Electricity Commissioners for the maximum price for electricity to be increased.

Bath.—New Plant.—The Electricity Committee has recommended that application be made to the Electricity Commissioners for sanction to the borrowing of £30,000 for the installation of a 1,500-kW turbo-alternator, and the erection of a sub-station at Tiverton.

Blackburn. — Electricity Supply.—The second turbo-alternator set at Whitebirk being in operation, the Electricity Committee is closing down the boilers and steam plant at the Jubilee Street works, and has decided to install a further rotary converter there. An agreement is to be entered into with the Preston Corporation under which reciprocal arrangements will be made for assistance with regard to their electricity undertakings, under Section 19 of the Electricity Supply Act, 1919. Application is to be made to the Electricity Commissioners for a Special Order authorising the agreement.

Cardiff.—Year's Working.—The annual report of the City Electrical Engineer (Mr. C. G. Morley New) for the year ended March 31st, 1922, records a total revenue of £168,370, an increase of £7,473 upon the previous year's income. Expenses debited to revenue account amounted to £100,201, as compared with £109,108, leaving a gross profit of £68,169 (£51,788). After the payment of capital and other charges the result was a net profit of £21,517, comparing with £23,711 in the preceding period. Out of this £15,000 was paid to the Borough Fund Account, £6,466 was utilised to defray expenses of sub-stations, &c., and the balance was carried forward. A total of £47,776 was spent on capital account during the year. The total energy sold amounted to 11,967,013 kWh, an increase of 1,344,662 kWh on the previous year's sales.

Chester.—Electricity Supply.—The Rural Council has asked the Mersey Power Co. for terms for extending its mains into the Council's area.

Chesterfield.—Electricity Supply.—The Electricity Committee has recommended to the Town Council a scheme for providing electric lighting for small houses. It is estimated that the cost of installation will be £7 per house, plus £3 10s. for the meter. To cover the cost, it is proposed to charge 1¼d. per kWh for the cost of installation, 1d. per kWh for meter, and 5¼d. per kWh for electrical energy, a total of 8d. per kWh.

Coalville.—Electricity Supply.—The Urban District Council has decided to obtain a supply of electricity from the Leicestershire and Warwickshire Power Co. The company proposes to lay a cable from Spondon to Hinckley, which would pass through Coalville. It is anticipated that the scheme will be completed within six months.

Continental.—Belgium.—Owing to the increased demands for electricity, the Société de l'Électricité du Pays de Liége has decided to erect a new power station with a capacity of 10,000 kW.

Spain.—*Hydro-Electric Development.*—The demand for electricity for lighting and industrial purposes is steadily increasing, and it is estimated that the total output at present is 600,000 h.p. and that the concessions granted represent 1,500,000 h.p. An important scheme is under consideration, known as the Saltos del Duero, which will be capable of supplying 300,000 h.p. The commencement of the work has been delayed by the intervention of Portugal, who has claimed a share as owner of territory on the banks of the Douro. The provinces of Salamanca and Zamora have protested against this delay, and have demanded that the falls on the rivers Esla and Tormés, which are situated in Spanish territory and represent 200,000 h.p., should be harnessed.—*Reuter's Trade Service* (Madrid).

Coventry.—New Plant.—The Electricity Committee has recommended that, in order to meet the anticipated increased demand for electricity next winter, new plant be installed at the power station at an estimated cost of £45,000.

Croydon.—Railway Siding.—The Town Council has decided to construct a railway siding at the electricity works. The estimated cost of carrying out the work and the purchase of land is £9,750.

Dover.—Electricity Charges.—The Town Council is applying to the Electricity Commissioners for sanction to increase the maximum charge for electricity to 9d. per kWh.

New Plant.—The Electricity Committee has recommended that the Town Council install two 1,500-kW turbo-alternators at the power station and that a consulting engineer be engaged to supervise the arrangements for the installation of the new plant.

Edinburgh.—Proposed Termination of Consultant's Appointment.—The Corporation Electricity Committee recommends that the appointment of Sir Alexander Kennedy as consulting electrical engineer to the Corporation shall be terminated, but without prejudice to his continuing to act for the Corporation in connection with the completion of any existing work or contract for the new Portobello station and relative sub-stations which he has in hand, and that for the future any new electrical construction or engineering work shall be carried out by the engineer and manager of the Electricity Department.

Electricity District.—South-East Lancashire.—The Electricity Commissioners have issued an Order constituting the above-named district and establishing the South-East Lancashire Electricity Advisory Board.

Ellesmere Port.—Electricity Supply.—The Mersey Power Co. has informed the Council of its intention to supply the district with electricity, and steps are to be taken to lay the mains shortly. It is hoped to complete the scheme by next winter.

Epsom.—Loan.—The Urban Council has applied to the Electricity Commissioners for a loan of £5,800 for a 200-kW heavy oil engine, dynamo, switchgear, &c., for the electricity works.

Forfarshire.—Electricity Charges.—An inquiry was held at Brechin on February 1st regarding the electricity charges of the North of Scotland Electric Light and Power Co., Ltd., by the Ministry of Transport. The Town Council protested against the price per kWh being increased to 1s., and also against the minimum charge of 10s. during the summer months and 15s. in the winter. For the company, Mr. Rye said that, so far as the company had been able to ascertain, the revenue for 1922 would be £5,450 and costs £3,425. There was about £250 available, even at 1s. per kWh, for interest on ordinary capital, which was at the rate of 2 per cent. If the price for electricity was reduced by 1d. per kWh, the company would have nothing for its ordinary capital, and the consumer would get a reduction of 13s. Assuming costs still fell, the charge of 1s. per kWh would have to be retained for some time. There would be an opportunity for revision in three years' time. Mr. Macpherson, for the Council, stated that the agreement entered into with the company provided for 4d. per kWh for public lighting and 6d. per kWh for general lighting. At the conclusion of the inquiry Mr. Rye asked that the maximum price and the minimum charge which the company asked for be confirmed. Colonel Ekin, who conducted the inquiry, stated that he would report to the Electricity Commissioners.

Glasgow.—Proposed New Power Station.—The Electricity Committee has appointed six members to confer with the General Finance and Parks Committee with regard to the purchase of a site for the erection of a new power station.

Gorseinon (Glam.).—Special Order.—The Gorseinon Electric Light Co., Ltd., has applied to the Electricity Commissioners for a Special Order authorising it to supply electricity for all purposes in the parish of Gowerton and part of the parish of Llanedy.

Guildford.—Loan Sanctioned.—The Town Council has received sanction to a loan of £10,000 for boiler and other plant, and a battery.

Ilford.—Loan.—The Urban Council has applied to the Electricity Commissioners for a loan of £2,000 for electrical cooking apparatus for hiring out, and £1,000 for the wiring of houses on the rental system. An electrical exhibition is to be held in the Town Hall, and a proposal to open a showroom and office for electrical goods, recommended by the engineer, has been deferred.

Irish Free State.—Ballybay.—The Town Council has decided to form an electric light company with a view to supplying the district with electricity. Approval of the Free State Local Government Board is being sought.

Japan.—Electrical Development.—According to investigations carried out by the Department of Communications, the number of electricity supply undertakings at the end of October last was 839, with a total capital of over 2,316,000,000 yen, and when the work of construction now in progress is completed they will be able to furnish 1,981,822 kW, of which 1,630,648 will be by water power and 351,174 by fuel.—*Reuter's Trade Service.*

Kettering.—Extension of Supply.—The Urban District Council has under consideration a proposal to extend its area of supply to include Rothwell and Desborough, and a canvass is to be made of the districts to ascertain the number of residents who would be willing to take a supply of electricity.

London.—Price Reductions.—The Westminster Electric Supply Corporation has decided to reduce the charge for electricity for lighting by ½d. per kWh from the March quarter's readings. The County of London Electric Supply Co., Ltd., has announced a reduction of charges for the lighting of business premises to 5d. + 50 per cent., for power to 2½d. per kWh. (sliding scale) + 60 per cent., and for heating to 1½d. per kWh + 60 per cent., from the March quarterly readings.

St. Marylebone.—In connection with the large extensions, contracts for which were detailed in our issue of January 26th, the Finance Committee proposes that applications be made for sanction to borrow the sum of £292,367; and that application be made, also, that the repayment of the loan may be suspended for at least two years. The latter recommendation was made after consideration of the probability of the undertaking's being vested in a Joint Electricity Authority. It was thought inequitable that the Council should have to pay sinking fund charges while the plant was not earning revenue, only to have it taken away when the joint authority commenced to function.

Hammersmith.—To encourage the use of electric lighting in shop windows after closing time, the Electricity Committee has instituted a special scale of charges. This is graduated from 1.75d. per kWh for the first 2,000 kW per annum down to 1.4d. per kWh for consumption in excess of 14,000 kWh per annum. From inquiries made it has been found that already 120 shops in the borough employ this method of advertising.

Lyme Regis.—Purchase of Undertaking.—The Town Council is negotiating with the Lyme Regis Electric Light and Power Co. for the purchase of its electricity undertaking.

Maidstone.—Loan Sanctioned.—The Town Council has received sanction to a loan of £17,266 for the provision of a new boiler and accessories at the electricity works.

Extension of Supply.—A canvass is being made of the residents at Loose with a view to extending the mains to that area.

Northern Ireland.—Kilkeel.—A scheme for the installation of electric lighting in the town has been sanctioned by the administrative commissioner for the rural district.

Ripon.—Electricity Supply.—In view of the unsuitability of the camp generating station, the City Council is to obtain the advice of a consulting engineer on the initial cost of erecting a small power station.

Rochdale.—Proposed Bulk Supply Approved.—The South-East Lancashire Electricity Advisory Board has approved the agreement between Rochdale and Milnrow Councils for a bulk supply of electricity to the latter Council.

Sheffield.—Fire.—A fire broke out at the power station on February 2nd, causing damage to the extent of £4,000. It is thought that the fire was caused by the overheating of one of the transformers.

Spalding.—Scheme Abandoned.—The Urban Council on January 31st decided not to adopt an electric lighting scheme for the town.

Stroud.—Special Order.—The Stroud Electricity Supply Co. has applied to the Electricity Commissioners for a Special Order authorising the company to extend its area of supply to include the urban district of Nailsworth and the rural district of Stroud.

Woodford.—Special Order.—The County of London Electric Supply Co., Ltd., has applied to the Electricity Commissioners for a Special Order authorising it to supply electricity for all purposes in the urban districts of Woodford, Buckhurst Hill, Loughton, and Wanstead, and the parish of Chigwell.

TRAMWAY AND RAILWAY NOTES.

Burnley.—Track Renewals.—The Town Council has decided to relay the Padiham Park Lane section of the tramways track, a length of 7,260 yd., at an estimated cost of £36,300.

Gateshead.—Doubling of Tramway Track.—The Gateshead Tramways Co. proposes to double the existing single-line tramway along practically the whole length of the Felling route. The Durham County Council has agreed to the Felling Council giving its consent to the scheme, subject to conditions as to widening the road, &c.

Glasgow.—Automatic Route Indicators.—The tramways manager is preparing a report on an offer from the Mynomont Syndicate, Ltd., to enter into a contract for the supply and installation on the tramway cars of automatic route-indicating and advertising machines.

Track Renewals.—The Tramways Sub-Committee on Works has recommended that the doubling of the Coatbridge-Airdrie route should be given out to contractors. Hitherto such work has been undertaken by the tramway department itself.

Halifax.—Track Renewals.—The Tramways Committee has recommended the Council to relay the following sections of the tramway track:—Double track from Westgate to Woolshops in Union Street (£2,000); outward track from Charlestown Road to Stump Cross (£9,343); inward track from Punch Bowl, Booth Town, to Woodside Road, with new points and crossings (£7,239).

London.—New "Underground" Trains.—Two additional six-car trains of the pneumatic-door type have been put into service on the Piccadilly line. This modern type of rolling stock has met with much public favour, affording as it does 65 ft. of doorway accommodation, as against 25 ft. in the older type of car.

London United Tramways.—The Law and Parliamentary Committee of the Hammersmith Borough Council has been notified that the London United Tramways Co., Ltd., has applied for an Order securing the maintenance of the fares authorised by the London United Tramways (Temporary Increase of Charges) Order, 1920. The Committee considers that the time has arrived when the necessity for making further Orders has passed and that, so far as the Hammersmith tramways are concerned, the company should be required to revert to the fares specified in its Act of 1918. Alternatively, the Committee thinks that a provision should be inserted in the Order that the actual fares charged on the lines in question should not be greater than those charged on the L.C.C. lines in the borough.

Salford.—New Type of Car.—The Tramways Committee proposes to experiment with a specially-designed low-roofed car on the Bury New Road. Owing to the bridges, it has not been possible to run the usual type of covered car.

TELEGRAPH & TELEPHONE NOTES.

Australia.—Police Radio Sets.—Tests were recently carried out in Melbourne by the Commissioner of Police to ascertain the desirability of equipping the force with motor-cars fitted with radio-telephone receiving apparatus as a means of facilitating the work of the police.

Extension of Time.—Owing to the lack of a receiving station in this country for direct communication with Australia, the Commonwealth Government has granted an extension of six months to Amalgamated Wireless (Australia), Ltd.

China.—Broadcasting.—In connection with the recent announcement that an American company intended shortly to inaugurate a radio broadcasting service at Shanghai, the Customs Commissioner has informed the company that any radio sets imported will be seized as contraband of war.—*Reuter.*

Irish Free State.—Improving the Telephone and Telegraph Services.—The Postmaster-General of the Irish Free State (Mr. J. J. Walsh, T.D., of Cork) gave some days ago in an interview a good idea of the intention of his Department fully and adequately to develop the telephone system in South Ireland. He said that it was his intention to introduce automatic telephones in Dublin and in other big centres. Mr. P. Mulligan, who had formerly served in England, had been appointed Engineer-in-chief of the Telegraph Engineering Department of the Irish Free State. In Free State Ireland they were at present completing a good many underground schemes, and there had been more cable-laying during the last 12 months than had been done in Dublin for 10 years previously. Plans had been laid for broadcasting based on a system selected from a number existing in other countries. It would be used largely for the agricultural and industrial development of the country. The Baudot type of instrument for telegraphic work was being introduced, and in this way the telegraphic service of the Irish Free State would be immensely improved in the near future.

Italy.—New Cables.—The Cabinet finally approved, on February 1st, conventions for three telegraph cables between Italy and South America, Italy and North America, *via* the Azores, and Italy and Greece. The two cables between South and North Amercia have been approved by Spain.—*Reuter.*

Radio-Telephony.—There is likely to arise a demand for private radio apparatus in Italy, where the popularity of the new method of communication is gradually increasing, and it is thought that the public will be allowed considerable latitude in the installation of private stations, with a consequent demand for small power plants, radio apparatus, and parts of all kinds.—*Reuter's Trade Service* (Rome).

Latin America. — Telegraph Developments. — Notwithstanding the rapid extension of wireless telegraphy throughout Latin America, several States are proceeding with additional cable installations; a number of concessions have recently been granted for new or the expansion of existing installations. In Brazil, widespread plans submitted by the All-America Cables (Inc.) for overhead telegraph lines and cable stations in Sao Paulo and Santos have been accepted, while similar plans submitted by the Western Telegraph Co. have met with consideration. Permission has been given to Senhor Enrico Sehoch to organise a company to construct and operate cables between Rio de Janeiro and Rome (Italy), and between Rio de Janeiro and Montevideo (Uruguay), but without special privileges, monopoly, or subvention in Brazil.

Radio Telephony.—Broadcasting has made progress in Brazil, indications pointing to a wide market in this State for receivers. The Rio de Janeiro Light and Power Co., a British enterprise, has recently completed a station, using a wave length of 483 metres. Radio apparatus entering Brazil has hitherto been of German or United States origin. Importers of such apparatus must first obtain a special permit issued by the Department of Transportation and Public Works. The Government has been approached upon the question of the abolition or modification of restrictions so as to admit of a wider market for radio apparatus.

A wireless service has been established between the Republics of Brazil and Mexico under treaties concluded between the two States through the Mexican Embassy in Rio de Janeiro. German enterprise is seeking to obtain a concession for the introduction into Mexico of radio-telephone broadcasting.

A considerable number of Government installations for radio broadcasting have been established in Chile, in addition to several private wireless stations in the capital (Santiago) and principal port (Valparaiso). The electrical laboratory of the University of Chile is daily broadcasting by radio programmes of music and current events.

New radio stations at Yacuiba and Esteros, in the south-eastern part of Bolivia, have been completed and tested.—*Reuter's Trade Service.*

Radio-Telegraphy.—London Conference.—A conference, the outcome of which is expected to be the linking-up of the world's radio stations, took place in London last week. The scheme proposes to pool the resources of the radio corporations of Europe and America, with the object of bringing the South American Republics within speaking distance of London, Paris, Berlin, and New York, and the lesser cities of the world as well. Concessions have already been obtained for erecting stations at Buenos Ayres, Rio de Janeiro, and in Colombia. National companies are being formed in each of the countries concerned, and the first station, that for Argentina, will, it is hoped, be ready for testing in June. The present negotiators are:—Britain: Mr. Godfrey Isaacs and Col. A. F. H. Simpson. America: Mr. Edward J. Nally. France: M. Emil Girardeau. Germany: Dr. Schapira. Mr. Nally is sailing for South America in March to be at hand for the preliminary testing of the new station at Buenos Ayres. "We have succeeded," said Mr. Nally, in an interview with an *Evening News* representative, "in persuading all the corporations of the world to mobilise their interests, their patents, their improvements, and their concessions for the purpose of building up a complete system of communication. Rio will have the most powerful station. It will be equipped both for telegraphy and telephony. When it is ready, probably in 14 months' time, Rio will be able to talk with England, France, Germany, the United States, and perhaps Italy." America, Mr. Nally pointed out, has now six stations capable of communicating with England, Japan, Hawaii, Germany, France, and Norway, which are capable of conversion into telephone stations as well.

New Broadcasting Stations.—The Cardiff station of the British Broadcasting Co., Ltd., which, it is hoped, will be functioning about Monday, February 12th, will have the call letters "5 W A" and a wave-length of 395 metres. The Glasgow station of the company, which is expected to be in service about the middle of March, will have the call letters "5 S C" and a wave-length of 415 metres.

Broadcast Music.—On February 1st the British Broadcasting Co. developed a new phase of its work by providing the music for a ball at the Savoy Hotel. The results are reported to have been very excellent.

Writtle Station.—Amateurs and "listeners-in" will learn with regret that they will no longer be entertained by the Writtle radio station, which has afforded so much enjoyment each Tuesday evening during the last 12 months. The Writtle transmissions were inaugurated by the Marconi Scientific Instrument Co., Ltd., one of the associated Marconi companies, in February, 1922, to provide British amateurs with material for experimental purposes which had not previously been available in this country, and proved to be of great value to the 12,000 amateurs who were interested before the broadcasting boom set in. The original programme consisted of telegraphic signals for calibration purposes followed by a musical programme, but now that there is an abundance of telephony available from the broadcasting stations, the Marconi Scientific Instrument Co. considers that its enterprise has served its purpose, and that Writtle may rest upon its laurels.

South Africa.—New Radio Station.—Although no definite decision has been arrived at regarding the site for South Africa's proposed radio station, the final choice rests between Paarl and a point on the 2-ft. gauge railway which runs northward from Kalabas Kraal to Hopefield, the centre of an important grain-growing district about 87 miles from Capetown. Other plans for the station are well advanced, and informal tenders have been invited from South African manufacturers for the supply of steelwork for the masts, and for the erection of the station buildings.—*British S.A. Export Gazette.*

Agreement with Marconi Company.—Upon the second reading of the Bill confirming the Government's agreement with the Marconi Company for the erection and operation of a high-power radio-telegraphy station, the Minister of Posts and Telegraphs outlined the agreement. He stated that the rates would show a reduction of a third as compared with ordinary cable rates and would stimulate competition. The British Government was being urged to construct a similar station to enable communication to be established in both directions. It was pointed out that the Bill did not confer a monopoly, but the company had full confidence of success.

The Telegraph Service.—Scottish Isles.—As the cable between Tiree and Coll, two of the Western Scottish isles, has broken down, the postal authorities have fixed up a radio station, says the *Daily Mail.*

United States.—"Broadcasting" Control.—The House of Representatives has adopted the Radio Control Bill, vesting broad powers in the Department of Commerce for the regulation and supervision of wireless telegraph and telephone communications.—*Reuter* (Washington).

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the* Electrical Review *in which the "Official Notice" appeared.)

OPEN.

Australia.—Sydney, N.S.W.—February 26th. Department of Public Works. Two electrically-driven stiff-leg derrick cranes for the Cordeau Dam.*

April 30th. City Council. Protective apparatus for the Pyrmont power house.

Hobart (Tas.).—April 9th. Postmaster-General's Department. Telegraph and telephone material.

Adelaide.—April 18th. Postmaster-General's Department. Telephone apparatus.*

Commonwealth Government.—16,750 Leclanché porous cells and 1,200 earthenware outer jars.*

Barking.—February 12th. County of London Electric Supply Co., Ltd. Condensing plant and auxiliary apparatus for the Barking power station. (See this issue.)

February 12th. Static transformers. (See this issue.)

Belfast.—February 19th. Electricity Department. H.p. 3-phase, 6-core, split conductor cables. (February 2nd.)

Belgium.—February 14th. Office de l'Electricité, 25, Rue de la Charité, Brussels. Supply and erection of l.p. switchboards, &c., at Luttre, Wendelgem, Denderleeuw, and Alost.

February 14th. The Belgian Post and Telegraph authorities at La Salle Madelaine, Brussels. 38 lots of miscellaneous telephone material.

Municipal authorities of Hognout (Province of Liége). Concession for the supply of electrical energy in the town.

Birmingham.—March 5th. Education Committee. Motor generators, transformers, and switchgear, for the Municipal Technical School. (See this issue.)

Bulgaria.—Sofia.—February 19th. Bulgarian Direction of Posts, Telegraphs and Telephones. Batteries and telephone material.*

Chile.—Santiago.—April 10th. Chilean State Railways. Electrical material.*

Clacton.—March 7th. Electricity Department. One 340-b.h.p. Diesel engine, one 225-kW multipolar shunt-wound generator, cooling plant, steel structure and pipework. (January 26th.)

Dewsbury.—February 21st. Town Council. Pumps and motors for the sewage disposal works. James Diggle & Son, consulting engineers, 14, Brown Street, Manchester, or Mr. H. Dearden, borough engineer, Dewsbury.

February 28th. Sewage screens, with electrically-driven raking and cleaning apparatus. James Diggle & Son, 14, Brown Street, Manchester, or Mr. H. Dearden, borough engineer, Dewsbury.

Dublin.—February 12th. Electricity Department. Disconnecting, dismantling, and removing one water-tube boiler, economiser, steel stack, pipe work and accessories at electricity works, Pigeon House Fort. City Electrical Engineer, Electricity Offices, Fleet Street.

Dundee.—Town Council. Electric welding machine for tramway work. Mr. George Baxter, M.Inst.C.E., city engineer.

Eastbourne.—Electricity Department. One 200-V single-phase, motor-driven, centrifugal boiler-feed pump. (February 2nd.)

Edinburgh.—February 13th. Tramways Department. Twenty-four air brakes suitable for tramway cars. Forms from manager.

Elland.—February 20th. Urban District Council. Electrical work required in connection with the alterations and additions to the sewage works. Mr. W. R. Nunns, 2, Albert Road, Saltaire, Bradford.

Egypt.—ZAGAZIG.—February 15th. Municipal Council. Two 20-kVA single-phase transformers.

Ilford.—February 10th. Urban District Council Electricity Department. E.h.p. and l.p. cables, feeder pillars and stoneware ducts. (January 26th.)

Leicester.—March 12th. Sewage Works and Farms Committee. Designs and quotations for steam, electrical, or other type pumping machinery in connection with the sewage disposal of the city. (January 26th.)

London.—LONDON COUNTY COUNCIL.—February 19th. L.p. electric cables, overhead electrical equipment. (February 2nd.)

STEPNEY.—March 1st. Electricity Supply Committee. River-water screening apparatus. (February 2nd.)

ST. MARYLEBONE.—February 28th. Electricity Department. Suction and discharge pipework and valves, h.p. steam pipework and valves, ash-handling equipment, electrically-operated jib crane or transporter equipment, e.h.p. and l.p. switchgear, annual supplies of underground cables. (See this issue.)

FULHAM.—February 28th. Electricity Department. Twelve months' supply electrical and engineering stores. Particulars from the Town Hall.

Londonderry.—February 28th. Electricity Department. Two water-tube boilers, with superheaters, economisers, stokers, steam and feed piping, coal elevators, &c. (February 2nd.)

Manchester.—February 13th. Tramways Committee. Portable loader. Mr. H. Mattinson, general manager, Corporation Tramways, 55, Piccadilly, Manchester.

February 16th. Electricity Committee. Six months' supply of electricity meters, potential and current transformers, and time switches. (February 2nd.)

Middlesbrough.—February 16th. Electricity Department. Twelve months' supply of a.c. meters. (February 2nd.)

New Zealand.—WELLINGTON.—March 27th. Lightning arresters.*

March 20th. 110 galvanised steel transmission-line towers complete.*

March 20th. 400 miles h.d. copper wire.*

CARTERTON.—March 31st. Wairarapa Electric Power Board. 11,000-V switchboard. Mr. P. H. Smith, manager, Carterton.

Pontllanfraith, Mon.—February 15th. Mynyddislwyn Urban District Council. Overhead distribution line, cables, services, two 75-kVA transformers, 11,000-V and 400-V, 3-h.p. switchgear. (January 26th.)

Portsmouth.—March 6th. Town Council. Electrically-operated jib crane. Mr. A. Ward, borough engineer.

South Africa.—JOHANNESBURG.—Municipal Council. February 14th. Electric cables. March 5th. Tramway spares.*

PORT ELIZABETH.—April 16th. Municipal Council. One 3,000-kW turbo-alternator, boilers, coal hoppers, coal conveyor, boiler house, steam and feed-water pipes, &c.*

CAPE TOWN.—Electricity Department. March 23rd. Two-phase induction voltage regulator.*.

Spain.—Municipal authorities of Vittoria. Concession for the electric lighting of the town during a period of 10 years.

Stoke-on-Trent.—February 7th. Electricity Department. Two steam jet air pump equipments; 18 months' supply a.c. and d.c. meters. (January 26th.)

Torquay.—February 26th. Electricity Department. Four 3-ph. to 2-ph. transformer groups. (See this issue.)

Tottenham.—February 20th. District Council. One electrically-driven capstan, complete. Engineer to the Council, Town Hall.

Tynemouth.—February 28th. Electricity Department. Switchboards for sub-station, transformers. (February 2nd.)

Uruguay.—MONTE VIDEO.—March 15th. State Electricity Works, 1,500 d.c. meters and accessories, 8,500 a.c. meters, &c.* March 10th. 66,000 metres of h.p. cable and accessories.*

Warrington.—February 19th. Electricity Department. L.p. lead-covered cable; transformers. (January 26th.)

* Further particulars can be obtained at the Department of Overseas Trade (Inquiry Room), 35, Old Queen Street, S.W.1.

CLOSED.

Abertillery.—Urban Council. Accepted:—

Plant in connection with a bulk supply of electricity:—

Static transformers and switchgear (£526).—Ferguson, Pailin, Ltd.
H.p. feeder (£1,295); overhead system (£4,191).—Johnson & Phillips, Ltd.
Converting set, 32 kW (£426).—Hewittic Electric Co., Ltd.
Rotary-converter equipment and h.p. switchgear (£1,762).—British Thomson-Houston Co., Ltd.

Australia. — MELBOURNE.—State Electricity Commission. Accepted:—

Boiler plant for the brown coal briquetting machinery at Morwell (£71,026.)—Babcock & Wilcox, Ltd. Messrs. Babcock & Wilcox will spend at least £44,000 locally.—*Reuter's Trade Service* (Melbourne).

Dearne Valley.—The Dearne Valley Light Railway Joint Committee has accepted the tender of the Consolidated Construction Co. for the construction of light railways between Barnsley and Manvers Crossing, including the districts of Wath-on-Dearne and Thurnscoe, at £200,243. According to the *Industrial Daily News*, the rolling stock and electrical plant will be made by the English Electric Co., Ltd., at a cost of £37,000; rails and fishplates by the Cargo Fleet Iron Co.; points and crossings, Edgar Allen & Co., Ltd.; and poles for overhead conductors, Stewarts & Lloyds.

Glasgow.—Corporation. Accepted:—

Electric lighting and power installation at the library (£288).—J. H. Hiddleston.

Tramway Committee. Accepted:—

Hexagon turret lathe.—A. Herbert, Ltd.
Telephone and test cable.—Pirelli-General Cable Works, Ltd.
Globe strain insulators.—British Insulated and Helsby Cables, Ltd.
Wells' lamps.—Dempster, Moore & Co., Ltd.
Steel wheels.—Reid Wheel Co.
Trolley poles.—Stewarts & Lloyds, Ltd.
Trolley wire.—Fred. Smith & Co., Ltd.
Steam pipes.—Scottish Tube Co., Ltd.
Wiring and bending machines.—Buck & Hickman, Ltd.; P. Bebbington.

London.—HAMMERSMITH.—Electricity Committee.

Lagging the new Stirling boilers and steam pipes (£120).—Newall's Insulation Co., Ltd. (Recommended.)
Drawing-in and jointing the new Bowden-Thompson e.h.p. main between the electricity works and Cadby Hall (£700).—Pirelli-General Cable Works, Ltd. (Recommended.)

Works, Cartage and Cemetery Committee.

One "Ironclad-Exide" battery (40 cells) (£218).—Chloride Electrical Storage Co., Ltd. (Recommended.)

ST. MARYLEBONE.—Borough Council. With further reference to the list of tenders published on pp. 142-3 of the ELECTRICAL REVIEW, January 26th, the recommendations were reached at the special meeting of the Council held on February 1st. Proposals, involving an expenditure of £292,367, for electricity plant extensions were approved. German and Swiss tenders were rejected, although they were lower in price, and the contracts were given to British firms. The Council decided to accept the General Electric tender, practically without discussion. An amendment to accept the tender of the Oerlikon Co. found no seconder. Among the contracts ratified were the following:—

12,500-kW turbo alternator and condenser (£45,000).—General Electric Co., Ltd.
Two 65,000-lb. marine-type boilers (£42,493).—Babcock & Wilcox, Ltd.
Fan-draught cooling tower and tank (£25,500).—Clyne Engineering Co., Ltd.
Three 2,000-kW rotary-converter sets (£22,365).—General Electric Co., Ltd.
One 1,500-kW ditto (£5,549).—Metropolitan-Vickers Electrical Co., Ltd.

The Council also considered and approved tenders for the builders' work and structural steelwork in connection with the proposed boiler-house additions, the Electricity Supply Committee recommending the tenders of Messrs. Ashby and Horner, Ltd., at £15,963 for the builders' work, and Messrs. Sanders & Foster, Ltd., at £15,338, for the structural steelwork.

Reigate.—Town Council. Accepted:—

Ironclad switchgear for the control of the generating station auxiliaries (£101).—General Electric Co., Ltd.

Salford.—Watch Committee. Accepted:—

Installation of electric lighting in the Detention House, Silk Street.—R. Rouse & Co.

Education Committee. Accepted:—

Installation of electric lighting at the Grecian Street Boys' School (£185).—J. W. Smith & Co.

Tramways Committee. Accepted:—

Tramway points, tongue, and crossings (£468).—Hadfields, Ltd.

Electricity Committee. Accepted:—

Portable blower for Blackfriars sub-station.—Lacy, Hulbert & Co.
One 100-kVA testing transformer (£154).—Ferranti, Ltd.
E.h.p. and l.p. cable (£2,361).—W. T. Glover & Co., Ltd.
Meter-testing equipment (£485).—Metropolitan-Vickers Electrical Co., Ltd.

NEW UNDERGROUND ROLLING STOCK.

A few months ago the London Underground Electric Railway Company. in search of the ideal type of coach for the tube railways, adopted the enterprising course of inviting five of the leading British manufacturers of rolling stock each to construct a car in accordance with its own views regarding the best practice, at the cost of the Underground Company. Each maker was given a free hand, subject only to compliance with existing railway standards and the condition that the doors should be at the sides and not at the ends of the cars. The firms concerned entered into the spirit of the competition with zest, and the five cars were recently delivered, together with one designed by the Railway Company; after undergoing their trials they will all be put into public service very shortly, in order that the company may form a decision, with the assistance of the passengers, as to which is the most suitable type for adoption, after which an order will be placed for new rolling stock based upon the experience thus gained. The various designs present a number of novel features, and differ materially, both inside and outside, from any type of car as yet adopted on the tube railways.

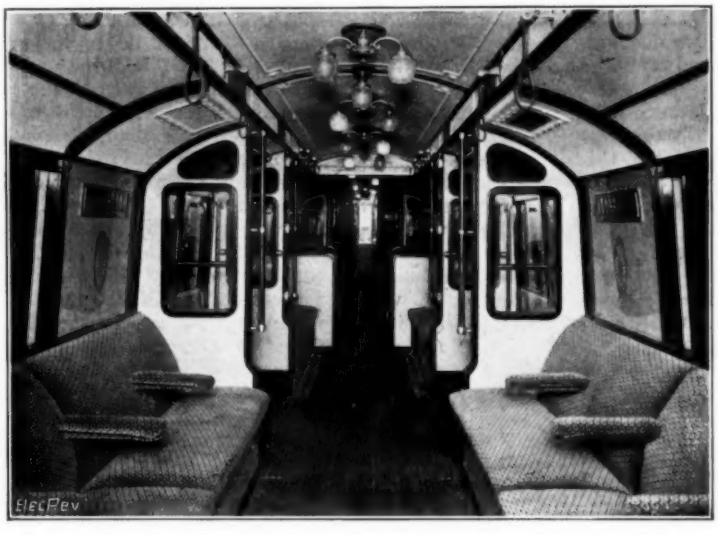

Fig. 1.—Interior of Car Built by the Birmingham Railway Carriage & Wagon Co., Ltd.

On Saturday last a large number of Press representatives were given an opportunity of inspecting the new cars and comparing their respective merits during a trial run from Piccadilly Circus to Finsbury Park in three of them, and from Finsbury Park to Barons Court in the other three. One of the special features of the experiment was an attempt to reduce the noise, which in the previously existing coaches was so great (in the tubes) as to render conversation almost impracticable, and this aim has been achieved to a marked degree, thanks mainly to a scientific investigation of the origin and mode of transmission of the noise, carried out by Prof. A. M. Low. Photographic methods of obtaining comparative records of the sounds were used, and it was found that most of the noise was due to the wheels, from which it was communicated to the metal frame and body of the vehicle, besides entering through open windows. Shrouding the trucks reduced the noise by preventing the sound waves from being reflected by the walls of the tunnels; packing the hollow roofs of the cars with sound-damping materials made a further marked improvement, and by adopting a system of ventilation which enabled the windows to be kept closed, an additional reduction of noise was effected. At the same time the pitch of the sound, which had previously approximated to that of the human voice, was lowered about one octave, thus greatly facilitating

Fig. 2.—Interior of Car Built by the Leeds Forge Co., Ltd.

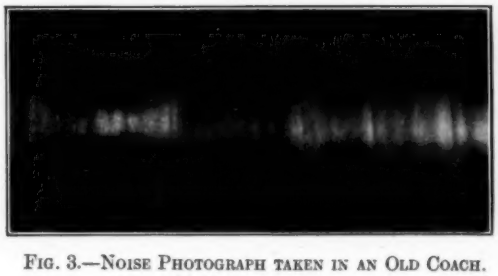

Fig. 3.—Noise Photograph taken in an Old Coach.

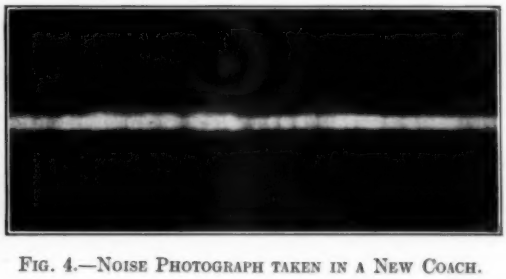

Fig. 4.—Noise Photograph taken in a New Coach.

On Saturday last a large number of Press representatives were given an opportunity of inspecting the new

conversation. The accompanying reproductions of Professor Low's photographic records strikingly demonstrate the degree of improvement effected, it being understood that the amplitude of the oscillations of the recording spot of light affords an approximate comparative measure of the noise.

In addition to those illustrated on p. 221, coaches were built by Messrs. Cammell Laird & Co., Ltd., The Gloucester Railway Carriage & Wagon Co., Ltd., and The Metropolitan Carriage, Wagon & Finance Co., Ltd.

All the new coaches are provided with two doors in each side. The positioning of the doors has always been a crucial problem in suburban railway traffic, which calls for the utmost rapidity in loading and unloading, but it has been proved by many experiments that the best solution is that mentioned above. With this arrangement short-distance passengers are induced to pass along the car instead of thronging the exits, for every seat is within easy reach of a door; moreover, passengers occupying the end seats are not disturbed by the continual opening and closing of doors and gates and by the usual "scrum" in their vicinity—no gates being used. Hence long-distance passengers will naturally prefer these seats. The doors are pneumatically operated, and until *all* the doors are closed the driver cannot start the train, so that the safety of passengers alighting is assured. The pneumatic principle has been in use on the railways for two years, corresponding to 600,000 train-miles, and has thus been proved to be thoroughly successful. Statistics show that with end doors the average stop at a station is 40 seconds; with side doors this delay is reduced to 20 seconds—a consideration of the first importance in this class of service. Alarm signals are provided in all the coaches.

The car bodies are all of metal, and the roofs, position and width of doors, exterior painting, air-operated doors, over-all dimensions, and seating arrangements are all similar. The cars all seat 48 passengers, except the Underground Company's car, which is a "control trailer" and seats 44. When, as the result of experience with the new cars, a standard design has been adopted, possibly combining the best features of each type, a number of new cars will be ordered for the Hampstead and City and South London lines between Hendon (Central) and Highgate and Moorgate, which service is to be opened in October, 1923; the time of journey will be 25 minutes, and the average speed, including stops, will be as high as 19½ miles an hour.

The new cars made a very good impression on the Press representatives, although they were by no means all of equal merit. The most marked differences were found in the very important feature of lighting; illuminating engineering did not appear to be the strong point of the coach builders, and though some striking effects were produced, our preference was unquestionably for the soft, pleasant illumination and freedom from glare observed in the Underground Company's own design. Two of the coaches were decidedly over-lighted, whilst some showed a lack of discrimination in the choice and arrangement of fittings.

RAILLESS TRACTION AT BIRMINGHAM.

At the invitation of Messrs. Railless, Ltd., on Wednesday, January 31st, a party of engineers, managers, members of local authorities, and representatives of the technical Press, interested in transport, travelled from London to Birmingham and were shown the trolley 'buses in operation on the Nechells route of the Birmingham Corporation tramways. At Birmingham the party was joined by others from the Midlands and the North, and was received by Mr. Alfred Baker, general manager of the Corporation tramways, members of his staff, and members of the Corporation, including Alderman Smith and Alderman James.

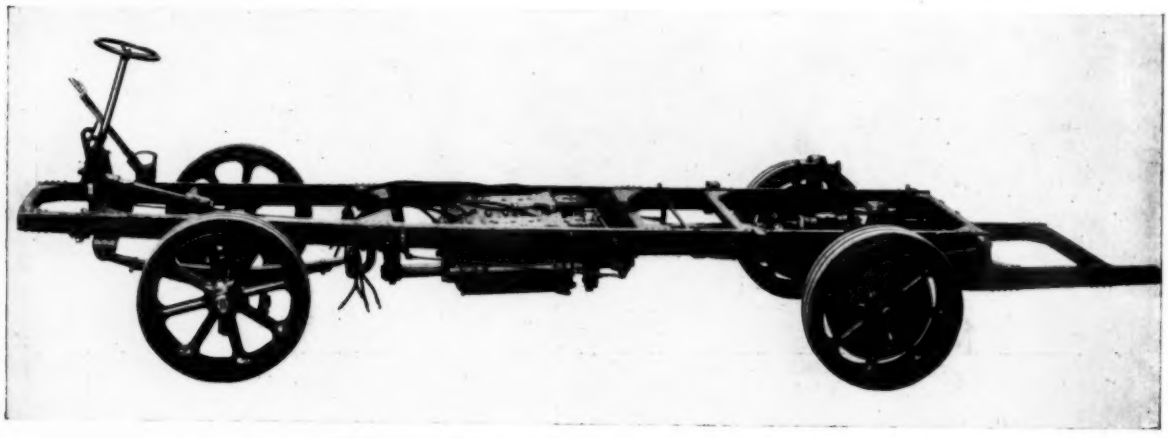

Fig. 1.—Chassis of "Railless" 'Bus, Side View.

This Birmingham trolley 'bus undertaking is of considerable interest. It is the most important service of the kind yet established; it takes the place of a tramway which has been in operation for many years, traverses an industrial district with a large population, and affords a greater frequency of service than the tramway which it has superseded. The results will therefore be directly comparable with those of the tramway, and they should contribute valuable information on the question of the line of demarcation between the tramway and the trolley 'bus as most economical town transport systems.

The Nechells tramway by the end of the war was, like many others, so nearly worn out that putting it into good order meant in effect complete reconstruction of the track, and it was estimated that the cost of this would entail such heavy capital charges that there would be a considerable annual loss on the operation. Alternative estimates for the trolley 'bus showed about the same amount as profit. Consequently the Corporation obtained the necessary Parliamentary powers for substituting trolley 'buses, placed orders for the vehicles with Railless, Ltd., added a second overhead conductor to the existing trolley wire along the route, and about the end of November last stopped the service of tramcars, putting the railless cars in their place. Since then much of the rail track has been lifted, and the paving made good, and this will shortly be completed.

The tramway route in question is about two miles in length, through narrow streets enforcing single line with turnouts, which limited the service to five minutes'

headway. At the Nechells end the line looped outwards by one street and inwards by another parallel with it, so that the length of track altogether was much greater than the route length. The trolley 'buses, having no limitation on their headway, are being worked on a

Fig. 2.—"Railless" 'Bus, End View.

four-minute service, so that the public is better served than it was by the less frequent tramway cars. Mr. Baker informed the party that comparing the last eight weeks of the tramway working with the first eight weeks of the trolley 'bus services, the car-miles and receipts were as follows:—

	Car-miles.	Receipts.	Receipts per car-mile.
Tramway, 8 weeks...	32,854	£2,589	18.9d.
Trolley 'buses, 8 weeks	45,726	£3,914	20.6d.

The 'buses ran 37.5 per cent. greater mileage, and collected 51.7 per cent. more money than the tramcars.

This result is gratifying. The eight weeks of the 'buses included the Christmas and New Year seasons, which might have something to do with the increased traffic. But it is a good start, and Mr. Baker, his committee, and the City Council will not be grudged the encouragement they must feel at having such a good push-off on their new venture. Naturally no comparative costs are yet available.

The technical details of the cars or 'buses are of particular interest. The Birmingham officials had available the information derived from the working of trolley 'buses in a number of places during the last fifteen years or thereabouts and a variety of designs and types of vehicles. These are substantially of pre-war design. The war interrupted development just when working experience might have otherwise resulted in considerable modifications of the types in use. This interruption at least prevented any settling down to stereotyped patterns. The Birmingham officials also knew accurately what they wanted in carrying capacity, since the volume and character of the traffic was already well defined. This is a condition quite different to that of the pioneer lines, where the traffic could only be guessed at, and trolley 'buses were tried in the main on routes where large traffics were not anticipated. Consequently the Birmingham 'buses, designed for a special job, with the benefit of experience gained elsewhere, present marked differences from, and a distinct advance on, the general and detailed features of such vehicles.

Figs. 2 and 3, giving side and rear end views of the cars, show their general lines and proportions. They are, of course, of the motor-'bus type on the whole, but with a roofed-in upper deck of the tramcar type. The roofed-in double deck is a new feature in trolley 'buses, *i.e.*, as a definite construction, though some have been built experimentally in ones or twos. The seating capacity is 51, 26 on the lower and 25 on the top deck. On the lower deck there are five transverse seats on each side for two passengers each, and two longitudinal seats at the rear for three passengers each. On the upper deck there are similarly six transverse seats for two passengers each on either side, and one single seat at the rear in the corner opposite the staircase landing. In respect of seating accommodation, width of aisle and entrances, these 'buses are much superior to the tramcars which they have displaced. Birmingham tramways are on the 3 ft. 6 in. gauge, with a maximum outside width of 6 ft. 6 in., and this narrow overall dimension has always pinched the designer and incommoded the portly passenger. The trolley 'buses are permitted an overall outside width of 7 ft. 6 in., and though the difference is not quite all available as body width—since the wheels and mud guards are a little salient—it is sufficient to make a substantial improvement in roominess and comfort. It is particularly useful on the top deck, as shown by the fact that the tramway cars have double seats on one side only and single seats on the other side of the aisle. In this respect the trolley 'buses are decidedly more attractive to the passenger than the tramcars, and this may have something to do with the increase in traffic already noted. The only criticism which occurred to one in respect of passenger accommodation is that the head room of the top deck compartment is somewhat small, which may make the temperature and atmosphere of the compartment rather trying in hot sunny weather. This reduced head room—as

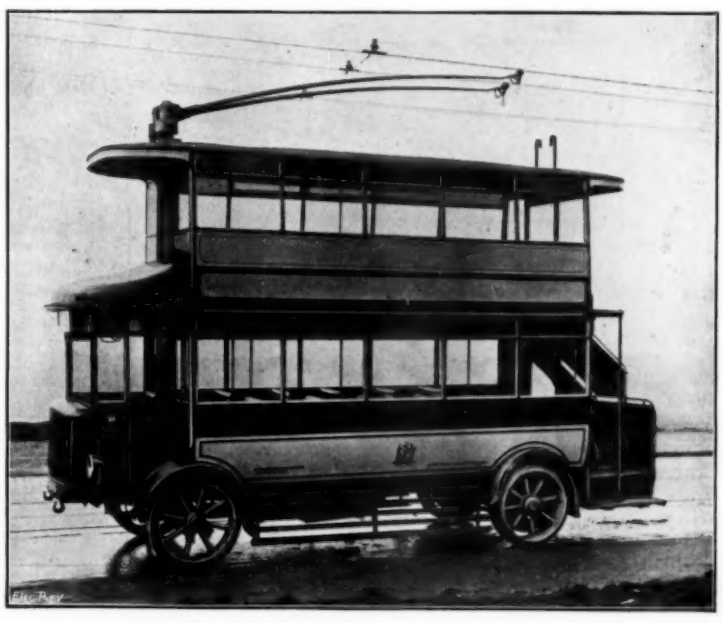

Fig. 3.—"Railless" 'Bus, Side View.

compared with tramcars—is obviously due to the greater wheel diameter and consequent greater height of the floor

from the ground. Possibly it will not be so prejudicial to summer comfort as one imagines.

The overall length is 24 ft. 6 in., wheel base 13 ft. 6 in., and overall width 7 ft. 6 in.; unloaded weight 7 tons 6 cwt., fully loaded weight 9 tons 18 cwt.; overall height, over the trolley standard, 16 ft. 3⅜ in. It has been calculated that the heeling limit of stability, fully loaded, is 36 deg., and the centre of gravity, also fully loaded, is calculated to be 5 ft. 2½ in. above the ground level.

The chassis, figs. 1 and 4, with its motor and driving arrangement, is interesting by reason of novelty. The frame is of pressed mild steel channel, stiffened by

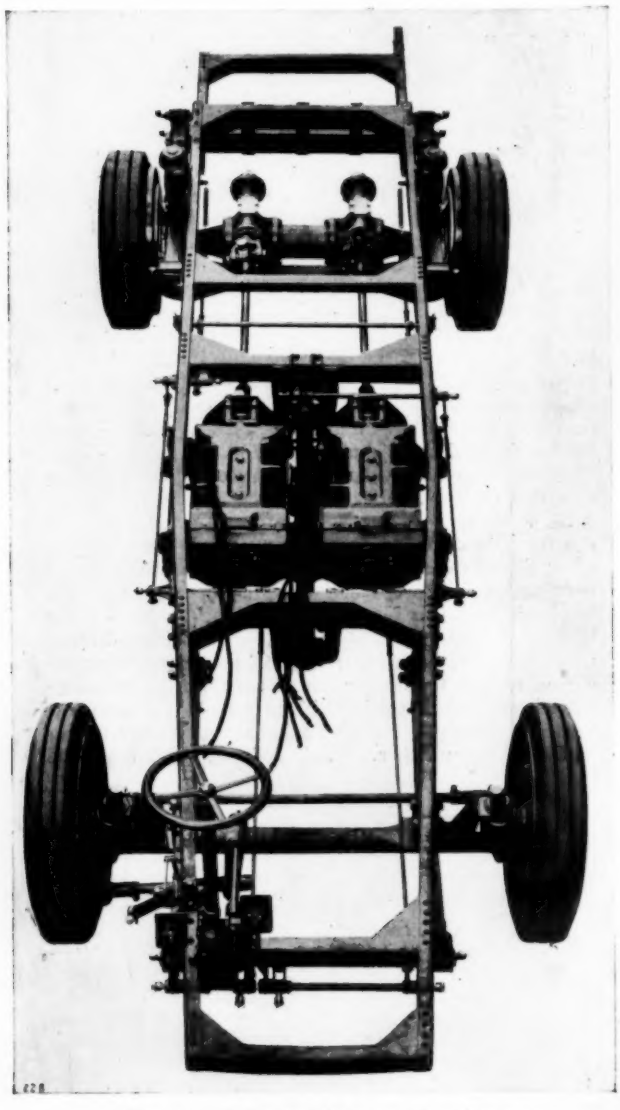

Fig. 4.—"Railless" Chassis, Plan View.

cross struts between the side members. The heaviest pair of struts are placed at each end of the slightly wider central length of the frame, fore and aft of the two motors, which lie side by side, and are carried by trunnions slung from the struts, passing through suspension bearings on the motor cases, similar to the axle bearings of a tramway motor. Each motor drives one of the rear wheels through a worm shaft. The rear axle is divided. It will be recognised that the two motors with their independent drives act as an electrical differential between the independent halves of the back axle. The worm wheels are of phosphor-bronze and the worms of special steel case-hardened and ground. The rear wheels are mounted on phosphor-bronze floating bushes. Roller and ball journal bearings and ball thrust bearings are used in the appropriate places. The steel casing of the worm gears can be opened for inspection of the bearings and gear without lifting the body, and is oil tight.

Two independent brakes are fitted, both applied by foot pedals. The ordinary or service brake is of the

Fig. 5.—Overhead Work on Straight Route.

internal expanding drum type, on the rear wheels. The emergency brake is a pair of external contracting drums fitted on the driving end of each motor shaft and housed in extensions of the motor cases. All the brake shoes are lined with Ferodo. Either brake is calculated to stop the fully loaded vehicle on a 1 in 10 gradient, and the service brake can be operated alternatively by a hand lever with ratchet to hold the brake on. The road wheels are of cast steel with hollow spokes, rim diameter 771 mm., fitted with single tires on the front

Fig. 6.—Overhead Work at Curve.

and double tires on the back wheels. "Super-resilient" Dunlop tires are used, and help towards the very easy riding qualities of the 'buses. The main springs are of the usual semi-elliptic laminated type, with supple-

mentary rubber springs fitted over the steel springs of the rear axle. These rubber auxiliaries come into action only at full load and overloads. Rubber shock absorbers are placed in the hangers of the rear springs.

The motors, made by the English Electric Co., Ltd., are of the series tramway type in their general features, but depart widely from standard tramway motors in respect of speed and rating in proportion to size. Their speed at the rated output of 42 b.h.p. and 525 volts supply is 1,130 r.p.m. This high speed means, of course, that they are much smaller and lighter than ordinary tramway motors usually rated at half or less than half the speed named. The worm gearing with a ratio of 12 to 1 permits the high speed and small size. The motors have four main and four commutating poles, and have Hoffmann ball bearings carried in the end shields. The motor control is series-parallel with field shunting notches to give the higher running speeds; there are five series and four parallel notches. The reversing and main barrels have the usual interlock. Only the reversing handle is detachable. The resistances and circuit breakers are of standard tramway type.

The car wiring is insulated on both poles, and to avoid the possibility of shock from accidental leakage, the metal grip rails at the steps are covered with insulating material.

Collection is effected by two trolley poles carrying wheels. To allow for lateral deviation, these poles are about 20 ft. in length; the bases permit of the poles swinging 180 deg., and the trolley heads are specially designed to allow the wheels to conform to the line of wire at any deviation of the poles. The two poles are independent, *i.e.*, either can be pulled down. This one-pole collection is necessary on the road between the 'bus route and the depôt at Washwood Heath, which has a tramway track and only positive trolley wires. On this road the negative connection is made by a trailed conductor from the rear. The contact is made by a line of five ribbed cylinders of cast iron, with iron balls between them, strung on a piece of wire rope. The collectors are laid in the rail groove, and keep to it very well, though with a display of sparking which must be quite attractive to the juvenile population.

The energy consumption up to the present recorded is at the rate of 1.75 kWh per 'bus mile. This is heavy compared with that of a tramcar of similar capacity, which would be heavier; but watt-hour meters are to be fitted on the 'buses, and a bonus will be given to the drivers for energy savings, which it is expected will bring down the consumption. It has to be observed also that the running so far has been in the winter months, and the road obstructions have been abnormal, owing to the removal of the rails and making good of the paving. These facts justify the expectation of lower energy consumption under normal conditions and with greater experience.

The overhead construction is generally of the tramway type, with the addition of a second wire. Double two-wire is provided throughout, so that 'buses in opposite directions do not interfere with each other. At the termini the double wire is carried in a loop on a segment of as large a circle as the streets permit. There is consequently no shifting of trolleys, the 'buses just run slowly round the loop.

The positive conductor is on the outside or offside throughout. Both wires are insulated by hangers, &c., of the usual type, and there is also a globe insulator or its equivalent between the positive and negative fittings. There are some special crossing guards provided at places where the 'bus route crosses tramway routes to maintain insulation between the positive tramway wire and the negative 'bus wire, whilst providing a safe track for the trolley wheels of both 'buses and cars.

Necessarily the double wires with their insulators are much more in the view than single tramway wires. The difference is not very striking on straight track, but on curves and at the crossings with tramway wires the appearance is rather heavy. Figs. 5 and 6 give two typical views illustrating the effects.

There are 12 'buses provided for working the service which, with the four-minutes' headway in use, leaves one spare. Birmingham, with its fleet of 12 trolley 'buses, becomes the largest user of this type of vehicle, with the exception of one company at Tees-side.

The running of the 'buses on the trip made by the invited party was very comfortable. The resilient tires and excellent springing rendered the movement very smooth, though the road condition is by no means ideal. There is very little noise; the worm gears are quite silent, in sharp contrast to the jar and rattle of the average tramway gears. The motors gave out a rather high-pitched note on acceleration, but nothing to worry anyone. Starting, acceleration, and braking were all smooth and quiet, and the steering was steady and even. The brake power was shown by stopping while descending a 1 in 11 gradient. The drivers seem to have got hold of the steering very well, though, as most of them were tramway drivers, it was a complete novelty.

There has not been time to obtain definite data about tire wear, but it is understood that the makers are willing to undertake maintenance on a 15,000-mile basis, which seems satisfactory for vehicles of this weight, power, and frequency of stopping. Experience with petrol-electric 'buses has shown that the even turning moment of electric motors increases tire life quite perceptibly, compared with the life with engine drive.

After the trip and inspection of the depôt, the party was entertained to tea at the Corporation tramway club.

On behalf of the Birmingham Corporation and Tramway Committee, Aldermen James and Smith welcomed the visitors, and said that so far as the short time permitted of judgment, the Corporation was well pleased with the working results.

Mr. Baker gave the party a more detailed account, including the figures of mileage and receipts during the last eight weeks of the tramway and first eight weeks of trolley-'bus working, already quoted above.

Mr. Wilkinson, of Bradford, a trolley 'bus pioneer, could not be let off without a speech. Bradford experience was entirely favourable. The cost of trolley 'buses was coming down, as they were becoming manufactured articles instead of single experiments. New double-deckers cost less now than the first single-deckers in 1912.

Mr. Baker, junr., who engineered the conversion and supervises the working of the trolley 'buses, said that operating troubles had been very slight and easily remedied. In particular, there had been no de-wiring, which he had thought might occur. The overhead conversion, about 2½ miles in length, had cost about £3,000.

The thanks of the visitors to Railless, Ltd., and to the Corporation and Tramway Department of Birmingham, for the facilities and information given and the hospitality extended, were duly voiced. The thanks of all who participated are due to Mr. Munro and his colleagues, of Messrs. Railless, Ltd., for their exertions for the comfort and refreshment of their guests, for the very interesting demonstration of the latest trolley 'bus and its working, and for information very cheerfully afforded. The Birmingham Corporation officials, especially Mr. Baker and his son, were liberal with their attentions and answers to questions, and must equally be thanked. Even the Clerk of the Weather did his part, bestowing a dry and pleasantly mild day.

A Large S.A. Pumping Installation.—The largest electrically-driven centrifugal pumping unit in Africa was started during December last at the Simmer and Jack mine. It consists of two Sulzer high-lift centrifugal pumps, coupled in series, driven by one 2,000-h.p., 1,500-r.p.m., slip-ring induction motor. On test at the mine the pumping set delivered in one single lift about 90,000 gal. per hour against a manometric head of 3,240 ft. The pumps are similar to, but larger than, those at the Randfontein Central, and were supplied by Messrs. Rice & Diethelm, Ltd. The motor was supplied by the S.A. General Electric Co., Ltd.—*S.A. Engineer and Electrical Review.*

FORTHCOMING EVENTS.

Association of Engineers-in-Charge.—Saturday, February 10th. At St. Bride's Institute, Ludgate Circus, E.C. At 7.30 p.m. Social and dance.
Wednesday, February 14th. At St. Bride's Institute, Ludgate Circus, E.C. At 7.30 p.m. Paper on "Hydraulic and Electric Lifts," by Mr. C. H. J. Day.

Salford Technical and Engineering Society.—Saturday, February 10th. At the Royal Technical College. At 7 p.m. Lecture on "Radio Telephony and Broadcasting," by Mr. H. G. Bell.

Birmingham and District Electric Club.—Saturday, February 10th. At the Grand Hotel, Colmore Row. At 7 p.m. Lecture on "Advertising and Salesmanship in Relation to the Electrical Industry," by Mr. J. W. Beauchamp.

Institution of Engineers and Shipbuilders in Scotland.—Tuesday, February 13th. At Rankine Hall, Glasgow. At 7.30 p.m. Ordinary meeting.

Institute of Marine Engineers.—Tuesday, February 13th. At the Institute, The Minories, E. At 6.30 p.m. Paper on "Internal Combustion and Economy," by Mr. T. D. Madsen.

Industrial League and Council.—Wednesday, February 14th. At Caxton Hall, S.W. At 7.30 p.m. Lecture on "Home and International Labour," by Sir Lynden Macassey.

Institution of Railway Signal Engineers.—Wednesday, February 14th. At the Institution of Electrical Engineers, Victoria Embankment, W.C. At 3 p.m. Annual general meeting.

Electro-Harmonic Society.—Wednesday, February 14th. At Caxton Hall, Westminster, S.W. At 8 p.m. Ladies' night.

Royal Society of Arts.—Wednesday, February 14th. At John Street, Adelphi, W.C. At 8 p.m. Lecture on "Progress in the Manufacture of Refractories," by Mr. W. J. Rees.

Institution of Electrical Engineers.—Thursday, February 15th. At the Institution, Victoria Embankment, W.C. At 6 p.m. Paper on "Some Problems in High-speed Alternators and their Solution," by Mr. J. Rosen.

(Scottish Centre).—Tuesday, February 13th. At 207, Bath Street, Glasgow. At 7.30 p.m. Paper on "Some Problems in High-speed Alternators and their Solution," by Mr. J. Rosen.

(Scottish Students' Section).—Friday, February 16th. At the Royal Technical College, Glasgow. At 7.30 p.m. Paper on "Light and Illumination," by Mr. G. Lennie.

(North-Eastern Centre).—Monday, February 12th. At Armstrong College, Newcastle-on-Tyne. At 7.15 p.m. Paper on "The Maintenance of Voltage on a d.c. Distribution System by means of a Fully Automatic Substation," by Mr. P. J. Robinson.

(South Midland Centre).—STUDENTS' SECTION.—Friday, February 16th. Paper on "Protection," by Mr. F. R. Coombes.

Chelmsford Engineering Society.—Thursday, February 15th. At the East Anglian Institute of Agriculture. At 7 p.m. Paper on "Modern Hoisting Practice," by Mr. C. H. Woodfield.

Chemical Society.—Thursday, February 15th. At Burlington House, Piccadilly, W. At 8 p.m. Ordinary scientific meeting.

Institution of Mechanical Engineers.—February 16th. At the Institution, Storey's Gate, S.W. At 6 p.m. Paper on "Some Mechanical Problems in the Rubber Industry," by Mr. H. C. Young.

British Electrical Development Association.—Friday, February 16th. At Caxton Hall, S.W. At 7.30 p.m. Paper on "Electric Power in the Home: Motor-driven Appliances," by Mr. L. J. E. Genner.

Junior Institution of Engineers.—Friday, February 16th. At 39, Victoria Street, S.W. At 7.30 p.m. Lecturette, "Notes on Some Insulating Materials," by Mr. T. L. Allison.

(North-Eastern Section).—Tuesday, February 13th. At Armstrong College, Newcastle-on-Tyne. Paper, "Notes on Shop Management," by Mr. L. C. Edmondson.

Royal Institution of Great Britain.—Saturday, February 17th. At 21, Albemarle Street, W.1. At 3 p.m. Lecture on "Atomic Projectiles and their Properties," by Sir Ernest Rutherford, F.R.S.

THE "ELECTRICAL REVIEW" SERVICE DEPARTMENT.

WE have to remind readers that Service Department inquiries should be accompanied by a stamped addressed envelope.

The makers or suppliers of the following devices are asked for:—

GILSONITE insulation.

NOTES.

A New Element.—Two Danish scientists, Messrs. Coster and Hevesy, recently announced in a letter to *Nature* their discovery, by X-ray crystal analysis, of the existence of an element previously unknown; this announcement reminded Dr. Alexander Scott, director of scientific research at the British Museum, of a substance which he had isolated in 1913 from black sand sent to him from New Zealand, but which he had not been able to identify. Further tests of this substance showed that it was identical with the new element abovementioned, called "hafnium" by the Danish chemists.

Hafnium belongs to the rare-earth group, and has the atomic number 72, coming next to tungsten in the scale; it may, therefore, prove suitable for the manufacture of electric lamp filaments.

The Electro-Harmonic Society.—The next concert (ladies' night) will be held in the Caxton Hall, Westminster, on Wednesday, February 14th, commencing at 8 p.m. Mr. Llewelyn B. Atkinson will take the chair. The following artistes are announced:—Miss Annie Rees, soprano; Miss Grace Ivell and Miss Vivian Worth, duettists; Miss Dorothy Varick, songs at the piano; Mr. Barrington Hooper, tenor; Mr. Lawrence Folker, bass-baritone; Mr. Bret Hayden, humorist; Mr. Charles Goodhead's piano and quintette.

Fatality.—Mr. Peter MacNaughton, electrical engineer at the Ballechin Distillery, Perthshire, was instantaneously killed by being caught in a pulley-wheel in the power-house.

Power Factor Measurement.—At a recent meeting of the Physical Society of London a paper on "Null Methods of Measurement of Power Factor and Effective Resistance in Alternating-Current Circuits by the Quadrant Electrometer" was read by Mr. D. Owen, D.Sc., F.Inst.P., Sir John Cass Technical Institute, London, in which he proposed the use of zero methods and derived expressions for the measurement of p.f. and the effective resistance of a.c. loads. The methods were extended to h.p. circuits, and the effect of "electrical control" of the needle of the quadrant electrometer was discussed, it being shown that the usual formula for the instrument was applicable only when the needle was maintained at its mechanical and electrical zero.

The L.C.C. and the London Electricity Supply Bill.—The Special Committee of the London County Council on London Electricity Supply reported to the Council on Tuesday last that one of the main purposes of the promoters of the Bill appeared to be to place the company in an independent position so far as the company electricity interests in the London district were concerned, and in a large measure to exclude its operations from control by any Joint Authority that might be set up. The Committee held that the company's proposals would deprive the authorities holding purchasing powers of their right to withhold consent to the suspension of those rights, and that the financial proposals of the company would call for considerable amendment. With regard to the policy embodied in the Bill, the Committee considered that the effect of the company's scheme would be to isolate the company areas and to postpone public control in those areas to 1971, without sufficient recompense for the valuable concession thus secured, and without any commensurate benefit to the public. Eventually some of the local authority undertakers might find it necessary to rely for bulk supply on "the new super-company" that it was proposed to set up. The Committee further held that any attempt to segregate the local authority and company electricity supply areas, without bringing them under the supervision of a common authority, would be opposed to the spirit of the Electricity (Supply) Act, 1919, and open to grave objections from an engineering point of view. The scheme of the company omitted to provide machinery whereby the interests of the consumers would be secured. The Committee, therefore, recommended "strong preamble opposition" to the measure, and the Council adopted this recommendation.

Lectures.—Mr. J. Anderson, M.I.E.E., delivered a lecture at the works of Mr. George Ellison, Birmingham, on January 30th, to an audience of about 200. His subject was "Circuit-Breakers *v.* Fuses," and the lecturer surveyed the types and principles involved. The speaker showed that the usually accepted figures of fusing currents for wires were incorrect, and detailed new figures based on tests. Pictures were exhibited of arcs with and without magnetic blow-outs, and the lecturer explained a method of determining the exact dimensions of the arc. From a study of the arc laws were deduced for the designing of circuit-breakers, and the circumstances in which either a fuse or a circuit-breaker should be used were detailed.

At a meeting of the Chelmsford Engineering Society, on January 2nd, Mr. W. H. Patchell, M.Inst.C.E., &c., gave a lecture on "The Development of Large Power Stations." Capt. H. Riall Sankey, C.B. (President), occupied the chair.

Mr. Patchell described the electricity supply system of the city of Detroit (U.S.A.) and the surrounding district, which is one of the largest and most highly-developed systems in existence. The area covered is 730 square miles and the electric supply company generates 4,000,000 kWh daily. The consumption per head of population per annum is 630 kWh. This has been achieved largely by propaganda work on the part of the company, which has large showrooms. Washing machines, flat irons, &c., can be tried for a week on approval and then returned if the prospective purchaser is not satisfied. The use of electricity has been increased in the country by charging the rural consumer at the same rate as the town consumer, instead of making the users of a new line pay for its construction.

The Coffin Foundation.—On May 16th, 1922, Mr. Chas. A. Coffin, in his 78th year, retired from the active leadership of the General Electric Co. (America). Mr. Coffin has been identified with the electrical industry since 1882, and was the founder of the American G.E. Co., which has established a fund of $400,000, to be known as the Charles A. Coffin Foundation, the income from which (about $20,000 per year) is to be devoted to the encouragement of the study and the application of the science of electricity. The G.E. Co. thus pays enduring tribute to the man who was its president from its organisation until 1913, and chairman of its board from that year until his retirement.

Fog Prevention.—During the past two months the Public Control Committee of the London County Council has been considering how far fog in London is caused by the pollution of the atmosphere due to preventable causes, and whether by the larger use of electricity the atmosphere of London might be improved. The Committee has also inquired whether further powers are required to deal with the emission of smoke, and detailed reports by the responsible officials of the County Council have been considered. It is understood that the Committee has reported in favour of further legislation.—*The Times.*

Interesting "Underground" Conference.—The Rt. Hon. Lord Ashfield was the chairman on the occasion of a gathering together of the Underground directors and over 100 members of the company's supervisory staff at the Princes' Galleries on January 29th. The object of the meeting was to hear the reading of the six reports by certain officials whom the company had sent abroad to study the traffic transport systems of other cities. Mr. George Watson (deputy chairman of the Associated Equipment Co., Ltd.), and Mr. D. E. Batty (experimental engineer of the same company), read papers describing their tours through the United States. These were followed by papers by Mr. A. L. Barber (commercial manager), Mr. A. V. Mason (deputy general manager and engineer, tramways), Mr. C. E. Stanier (civil engineer), and Mr. J. Thornton (superintendent of the line), all of whom had toured Germany, Switzerland and France. Interesting comparisons of the traffic facilities were made, and all four papers—which were illustrated with lantern slides—were warmly applauded. The company subsequently dined together.

Educational.—Borough Polytechnic.—On February 2nd, the Rt. Hon. Sir Douglas M. Hogg, P.C., M.P., H.M. Attorney-General, distributed prizes to successful students of the Borough Polytechnic. Sir Douglas Hogg referred to his long connection with the Polytechnic movement, mentioning that his father, Mr. Quintin Hogg, was the founder of the Regent Street Polytechnic.

Board of Education Examinations.—The Board of Education has issued a leaflet (Form 67U) giving details of the 1923 examinations for Royal Scholarships and other awards in science, and for Whitworth Scholarships and Whitworth Senior Scholarships. The examinations extend over the period from April 30th to May 16th.

Willesden Polytechnic Electrical Engineering Society.—The annual general meeting for the election of officers of the Society will be held at the Willesden Polytechnic Institute tomorrow (10th) at 4 p.m. This is to be followed at 4.30 by the ordinary general meeting, when an address will be given by the President (Mr. Frederic H. Taylor) on "The Use of Electricity in Churches."

Machinery in Mining.—Mr. J. W. Burr, the Swansea borough electrical engineer, at the recent annual dinner of the South Wales Branch of the Institution of Mechanical Engineers, said that it was not generally realised to what extent machinery was used in the coal industry. He was present at a meeting when a gentleman whose name was a household word with colliery people all over the country, stated that for every ton of coal raised to the surface an average of 20 kWh of electricity was consumed, and, as he pointed out, as the coal output of South Wales alone was between 40 and 50 million tons per annum, the energy required was over 1,000 million horse-power-hours annually. That would give some idea of what would happen to the coal-mining industry if mechanical appliances were not available.

Diesel Electric Ship Propulsion.—Information which will enable American shipping interests to equip the nation's merchant marine with motive power and auxiliary equipment at a cost that will put them on a "parity with foreign vessel owners as to capital investment," is expected to be developed at a conference at Philadelphia before March 1st, Rear-Admiral Benson, retired, of the U.S. Shipping Board, announced on January 17th.

Shipbuilders and manufacturers of Diesel engines and of electrical equipment will meet him, Admiral Benson said, in an effort to work out a plan for standardisation "that would permit quantity production and consequent reduction of costs" of equipping vessels with modern crude oil-burning engines. He presented such proposals to the builders and manufacturers at a meeting in November, and they were discussed further in December.—*Reuter's Trade Service* (Washington).

Continental Electrical Journals.—With the New Year the *Elektrotechnik und Maschinenbau*, of Vienna, celebrated its fortieth year of existence by the issue of a bulky number containing 76 pages, filled with expert articles and special news. The first article is a general review of the progress of electricity in the past 10 years; other articles deal with the steam power station; the development of water-power plant; the building of transformers and railway motors; mining electrotechnics; the utilisation of water power in Austria; and Vienna's municipal electricity works, each being exhaustively handled. In an article devoted to Austria's foreign trade for the first nine months of 1921 and 1922, it is noteworthy that all the items of imports show a decline, the quantities being 32,230 quintals in 1921 and 24,865 in 1922, while all export items are less, save lamps and insulating material, the totals being 84,337 quintals in the former year and 69,563 in 1922.

The 21-year-old Munich journal *Elektrische Kraftbetriebe und Bahnen* appears with its January 10th issue under the style of *Die Elektrische Betrieb*, as more expressive of its particular mission. The paper has sadly diminished in bulk since pre-war days, having now only 12 pages, including covers—significant of altered times and circumstances in the electrical industries of the Vaterland. The journal gives particulars of a testing competition organised by the Metal Economy Committee for "binding and fastening parts of aluminium or aluminium-steel conductors," to facilitate the use of such conductors in the construction of armatures. The competition is an international one, but no prizes are offered; but "the spiritual property of the sent-in armatures will remain with the finder or sender." Constructions sent in will be exhibited in a special exhibition open to all, but those withheld by request will not be published. Nearly four columns regarding the details of this singular competition are given, by our German contemporary, which may be obtained by those interested by applying to the Beratungsstelle des Metallwirthschaftsbunds, 122 *a* and *b*, Potsdamerstrasse, Berlin, W.35.

Electric and Heat Waves.—Physicists have finally succeeded in bridging the gap between the electric wave and heat-wave spectra by obtaining electric waves as short as the longest heat waves, and by detecting heat waves with electric wave receivers.

Dr. Ernest Fox Nichols, director of pure science at the Nela Research Laboratories at Cleveland, and Dr. J. D. Tear, assistant physicist at the same laboratories, announced in a paper presented to the American Physical Society meeting recently in Boston that by the aid of newly designed and more sensitive instruments and improved methods of experimentation they had succeeded in generating, receiving, and measuring electric waves half a millimetre or one fiftieth of an inch in length. For comparison, the ordinary radio transmission is by electric waves of the order of half a mile long.

Rubens and Von Baeyer in 1911 obtained heat waves one third of a millimetre long from a quartz mercury arc. The shortest electric waves just obtained are, therefore, of about the same length as the longest waves sent out by hot bodies.

As a latest proof of the identical character of light, heat, and electric waves, Dr. Nichols and Dr. Tear have succeeded in using two different types of electric wave receivers to detect and remeasure Rubens' and Von Baeyer's long heat waves.

As a by-product of the investigation, the long-wave emission from the quartz mercury arc has been found partially polarised, a fact which throws new light on the activity of the ions which emit this long-wave radiation. Dr. Nichols and Dr. Tear have also found that the radiation can be isolated from the complex total emission of the mercury arc by simply sifting it through two thicknesses of black paper, thus avoiding the elaborate focal isolation method and apparatus previously thought necessary to accomplish this separation.

Dr. Nichols was president of the Massachusetts Institute of Technology from March to November, 1921.—*Science.*

INSTITUTION NOTES.

Institution of Electrical Engineers.—Annual Dinner.—A distinguished company was present at the annual dinner held at the Hotel Cecil on Tuesday evening, about five hundred members and guests attending. Mr. Frank Gill, O.B.E., presided, and the gathering included a number of well-known public men, past-presidents, and representatives of kindred institutions.

After the loyal toasts, the President read a letter from the Prince of Wales, expressing regret that prior arrangements prevented his attendance. Messages from the Société Française des Electriciens, the Associazione Elettrotecnica Italiana, and the American Institute of Electrical Engineers were also read.

In proposing the toast of "The Institution of Electrical Engineers," Sir William Joynson-Hicks, Bart., M.P., (Parliamentary Secretary, Department of Overseas Trade), said that he considered the Institution one of the marvels of modern days in its rapid growth. This was due not only to the importance of the electrical industry, but because of its objects—the advancement of knowledge and the improvement of practice—a motto which Government departments might take for their own. The Institution by encouraging research could aid overseas trade to a large extent. The co-operation of the scientist and the commercial man made for good progress. Another feature of the Institution's work was the encouragement of foreign students; one student returning home was worth ten commercial travellers. The Institution had also done extremely good work in securing the standardisation of appliances and materials, making British quality renowned throughout the world.

The President, in reply, said that although in the past year there had been a decline in electricity supply, it was estimated that in the next five years an increase of 92 per cent. would occur, and in ten years the increase would be 192 per cent. He urged careful consideration of the closing of small stations which could not be economical, and retared development. It had been shown in Switzerland, on the North-East Coast, in the United States, and Canada, that only by means of large stations—enlargement and unification—could electricity progress and attain its proper position. Referring to international telephony, the President said that the French Government had made a move in the right direction by calling a meeting of national representatives which would probably be held next month. The question must be tackled boldly by arranging unity of control. As regarded the Institution itself, there was now a membership of 10,600, and in the past four years it had increased at the rate of 9 per cent. per annum. Fifty per cent. of the membership was catered for by the twelve local Centres and Sub-Centres. He expressed his thanks to all officers, and to the headquarters staff. Mr. Gill said that members owed allegiance not only to their Institution but to their nation, and

mentioned that the London Electrical Engineers had recently been revived as the 11th Anti-Aircraft Battalion, R.E., and recruits were urgently required.

Mr. J. S. Highfield (past-president) proposed the toast of "Our Guests" in a humorous speech. He referred to suggestions regarding the amalgamation of engineering institutions, and while deprecating this, considered that something should be done to provide a common voice for the institutions in matters that concerned them all.

Mr. Neville Chamberlain (Postmaster-General), responding, said that there was no Government department so intimately concerned with the electrical industry as the Post Office. He endorsed the view of a previous speaker that we were only at the eve of still greater discoveries in electrical science. He wished success to the Institution from which so much had been received, and so much was expected in the future.

Sir Arthur Colefax, K.B.E., K.C., also replied, and paid special tribute to the work of the Secretary. He acknowledged his indebtedness to the electrical experts, who, in legal cases, put him in possession of much more knowledge than the unfortunate judge possessed who had to try such cases.

At the conclusion of the toast list, the company adjourned to the Victoria Hall for the re-union, which is a special feature of the annual dinner. During and after dinner music was provided by the British Imperial Orchestra, under Mr. Arthur Crudge.

It has been found in past years at the annual dinner of the Institution that the speeches made by the President and others have not been heard by everyone present. In order to overcome this difficulty the "Public Address System" was installed this year to enable each of the speakers to make himself heard without difficulty by all members present at the dinner. The public address system is a telephonic system in which the speaker's voice is transformed into electrical vibrations by a sensitive microphone, which is placed on the table in front of him. The vibrations set up by the microphone are transmitted to an amplifier, which magnifies them without noticeable distortion; the reinforced voice currents are then led to projectors suspended above the speaker's head at a height of 20 to 25 ft. The trumpets of the projectors are pointed downwards over the audience at the correct angle, so that the area to be covered is efficiently served at the proper intensity of loudness, giving a person situated in any part of the hall the impression that it is actually the speaker he hears rather than the instrument.

The number of projectors required in the Grand Hall at the Hotel Cecil for the assistance of each speaker at the Institution dinner was three, and there were two such groups of projectors. The first group was suspended immediately above the President, and the second at the other side of the hall over the position occupied by the immediate Past President. According to the statements of members who were seated a long way from the speakers, the system was very effectual in enabling them to hear the speeches.

The switching on and off of the requisite projectors was done by the attendant at the amplifying apparatus, which was installed in the gallery.

Local Hon. Secretaries Abroad.—The Council has appointed Mr. Gano Dunn and Mr. M. L. Kristiansen to be local hon. secretaries of the Institution, for the United States of America and for Norway respectively.

Summer Meeting, 1923.—The Council has accepted an invitation from the Committee of the North-Western Centre to hold the summer meeting of the Institution in Manchester, Liverpool, and North Wales, from June 5th to 8th.

Members Visiting the United States.—Attention is drawn to an arrangement between the Institution and the American Institute of Electrical Engineers for the mutual granting of facilities and privileges as visiting members to members of the two societies visiting each other's country. Members who intend to visit the U.S.A. and wish to avail themselves of the arrangement should apply to the secretary of the Institution for a letter of introduction to the American Institute, stating in what branch of the profession they are engaged and giving the name of the firm or company (if any) with which they are connected.

Western Centre.—At the meeting of the Centre at Cardiff on February 5th, in the unavoidable absence of the chairman (Mr. F. Tremain), the vice-chairman (Mr. C. T. Allan) presided over a numerous attendance, which included Mr. William Johnson, president of the South Wales Institute of Engineers. After routine business had been disposed of, Mr. J. Rosen, M.I.E.E., read his paper on "Some Problems in High-Speed Alternators and their Solution," and the chairman, in introducing Mr. Rosen, remarked that the paper had not yet been read at headquarters. Several interesting lantern slides were shown and a long discussion ensued which was extended to a late hour.

Liverpool Centre.—At the annual dinner, the President announced that, with the approval of the North-Western Centre, the Liverpool Sub-Centre was being "promoted" to the grade of Centre.

Junior Institution of Engineers.—The annual dinner of the Midland Section was held on January 30th, in Birmingham. Dr. C. C. Garrard, the chairman, presided, and arranged for the reception of a radio-telephone concert from the Witton broadcasting station. Among the speakers were Mr. J. W. Hall (Institution of Mechanical Engineers), Mr. H. V. Pointon (chairman of the Institution), Mr. F. Forrest (Birmingham Electric Supply Department), and Prof. W. Cramp (chairman, South-Midland Centre, I.E.E.). A number of medals and other awards were made by the president to members for papers read during the past session.

Association of Mining Electrical Engineers.—The Glasgow magistrates have recommended that the Association be accorded a civic reception on the occasion of its annual meeting in the city, from June 28th to 30th.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

At the meeting of the Institution of Electrical Engineers on February 1st, Mr. F. Gill (the President), in presenting a silver tray and a silver cigar and cigarette box, both suitably inscribed, to Mr. J. W. Meares, explained that they were a mark of appreciation from Mr. Meares's colleagues in India on his retirement from his official position there after 25 years' service, but it was found impossible for the presentation to be made before Mr. Meares left India. Mr. Meares, after being trained at Llanelly and Chelmsford, joined the Hove Electric Lighting Co. In 1896 he went to India to take charge of a hydro-electric installation, and two years later he became electrical engineer to the Government of Bengal. In 1905 he was appointed electrical adviser to the Government of India, and in 1918 he became chief engineer to the Hydro-

Photo by] [*Elliott & Fry.*

Mr. J. W. Meares.

Electric Survey of India. From 1911 to 1914 he also held the position of Controller of Patents in India. The Institution had only one wish, and that was to do all it could to honour any man who had done service such as Mr. Meares had done, and who had earned the gratitude of all with whom he had come in contact. He had the greatest pleasure in presenting the gifts as a mark of esteem and regard and, he might say, affection on the part of those with whom Mr. Meares had been associated in India.

Mr. J. P. Griffin (Delhi Electric Lighting and Tramways Co.), as one who had worked in one of the provinces which had come under the jurisdiction of Mr. Meares, said that Mr. Meares had consistently and conscientiously endeavoured to further the interests of the electrical industry in India. He had been at all times anxious to help the supply engineers in India, who felt that in his retirement they had lost an excellent friend.

Mr. Meares, M.Inst.C.E., M.I.E.E., M.I.E.(Ind.), in replying, said that the fact that the presentation was made by the Institution of Electrical Engineers—of which he

had been a member for 30 years and for which he had been able to do a little work as local honorary secretary in India for some time—added to the pride which he felt on this occasion. He had often regretted that he forsook real engineering for the administrative and advisory work of a Government office. A Government official must be born and not made, and one who became an official after previous experience of commercial life found certain difficulties. Sir Thomas Holland, chairman of the Hydro-Electric Survey, who was present that evening, could probably tell them that he had suffered at his (Mr. Meares's) hands, and probably some of his colleagues in the provinces would say the same. As a matter of fact, he did not always see eye to eye with the manufacturing and supply interests in India, a point upon which Mr. Griffin could have spoken if he had chosen. In his official position, however, he had had to think about the purchaser, the consumer, and the Government, but on the whole they were a very happy family. At the same time, he was rather glad to be out of it. Just at the end of his career in India he went back into real engineering, and was placed in charge of the hydro-electric survey. He was very pleased indeed to have had a hand in that piece of work, in which a small band of enthusiastic engineers worked with him for three years under great financial difficulties. That work, however, would have far-reaching effects in India when the country had settled down again, financially and otherwise. In that connection he expressed the hope that the new rain gauge which he brought out before he left India would help forward the great problem of rainfall in India, a matter upon which the irrigation of India depended very largely. On the whole, he thought he could say he was satisfied with his 25 years' work in India. At the moment, the Indian Civil Service was at the cross roads, but the civil engineer had cause to be proud of what he had done for the material progress of India in irrigation, railways, &c., and the electrical engineer had done a lot to ameliorate the conditions of life for all classes and creeds in India. The electric fan had probably worked the biggest revolution that had ever taken place in a tropical country.

There were 62 subscribers towards the presentation, and at Mr. Meares's request Col. J. S. Pitheathly (who got it up) limited the list to Mr. Meares's friends and colleagues who had been closely associated with him professionally in India—not only electrical, but also civil, mechanical, official, and non-official.

Concerning Mr. J. W. Kirkland (managing director of the South African General Electric Co., Ltd.), who is coming to London as manager of the International General Electric Co., New York (the parent company of the S. African company), the *British and South African Export Gazette* says:—"Since his arrival in South Africa in 1898 . . . Mr. Kirkland has been closely associated with every aspect of engineering development, and has at one time or another been prominently connected with nearly every South African engineers' organisation. His mental vigour and wide knowledge and experience will be missed by all who have come into contact with him in Johannesburg or elsewhere." A Cape Town paper reports that the South African Institution of Engineers recently tendered its congratulations to Mr. Kirkland on his appointment.

Salford Electricity and Staffs Committees have recommended the appointment of Mr. D. E. Lang as resident civil engineer in connection with the construction of the Agecroft generating station, at £600 per annum.

Mr. G. C. Weston, M.I.E.E., A.M.I.Mech.E., has been appointed chief engineer of the Kensington and Knightsbridge Electric Lighting Co., Ltd.

We are informed that Mr. A. E. Loe is no longer representing Messrs. Electrical Components, Ltd., in the Leeds district.

After 21 years with Messrs. George Hatch, Ltd., Mr. Thos. P. Headland is commencing business on his own account at Trafalgar Buildings, 1, Charing Cross, London, W.C.2.

St. Marylebone Electricity Supply Committee reports that Councillor Dr. V. H. Veley, F.R.S., has resigned from the Committee.

On January 29th, at the annual dinner of the staff of the Bury Electricity Department, Mr. T. Mahon (the oldest employé, who has been at the works since a date prior to the appointment of Mr. Watson and the opening), on behalf of the staff, presented Mr. Watson, who has just resigned the position of electrical engineer, with a barometer.

Wallasey Town Council has appointed Mr. H. H. Lincoln, of Sheffield, as tramway general manager in succession to Lt.-Col. R. R. Greene, retired, at an inclusive salary of £550 per annum. For the past 15 years Mr. Lincoln has occupied the position of assistant engineer to the Sheffield Tramway and Motor Department.

Mr. R. B. Archibald, lecturer in electrical engineering at Dundee Technical College, is leaving to take up the post of senior lecturer in electrical engineering at the Royal Naval College, Plymouth. Mr. Archibald has been in Dundee for the last 13 years. He has been chairman of the Sub-Centre of the Institution of Electrical Engineers.

The Lancaster Council has confirmed the appointment of Mr. F. Chilcott, London, as temporary engineering assistant in the electricity department at a salary of £380.

Mr. W. G. Watson, managing director of W. G. Watson and Co., Ltd., electrical engineers and merchants, of Sydney, Australia, is shortly visiting England, *via* America, on business, and he expects to arrive in London about May 15th. Letters should be addressed, care of Messrs. A. Murray Coombs & A. F. W. Richards, 150, Southampton Row, London, W.C.1.

On the retirement of Sir William Marwood, K.C.B., which took effect as from January 31st, 1923, Mr. J. R. Brooke, C.B., has been promoted to be Secretary to the Ministry of Transport.

Mr. Alexander Pope, South African representative of the Chloride Electrical Storage Co., Ltd., has been elected a member of the South African Institute of Electrical Engineers.

Mr. William Doyle, of the Dublin Telegraph Department, has now retired, after 39 years' service, during which he held the posts of superintendent, and expert administrative and technical officer.

The following additional Post Office appointments have been made:

Mr. W. H. U. Napier, Deputy Controller of the London Telephone Service, in succession to the new Controller, Mr. W. A. Valentine and Mr. M. C. Pink, Assistant Controller, London Telephone Service. Mr. J. F. Edmonds, Chief Inspector of Telegraph and Telephone Traffic in the Secretary's office, and Mr. W. D. Stewart, Inspector of Telegraph and Telephone Traffic in the Secretary's office.

Obituary.—Mr. Mark Robinson.—We record with feelings of deep regret the death of Mr. Mark Robinson, which occurred on Friday last at his residence at Kingston-on-Thames. For some years past Mr. Robinson had not been so actively engaged in engineering and business affairs as was the case, say, 20 years or so ago, when he formed so familiar a figure at engineering conferences and in affairs in which the well-known company, Willans & Robinson, was interested. Mr. Robinson was born at Sheerness in 1844, and was therefore in his 79th year. He was the son of Commander Edward Robinson, R.N., and was educated at the Royal Naval School at New Cross. The firm of Willans & Robinson was founded by the late Mr. Peter W. Willans and Mr. Robinson in 1881; the business was subsequently turned into a limited company, and when Mr. Willans died in 1892 Mr. Robinson became its chairman. For very many years he devoted his attention to the development of high-speed steam engines, and these found their way into large numbers of electricity works. He joined the Institution of Electrical Engineers in 1888, was awarded the Institution premium, also the Willans premium, and became a member of Council. He was also a M.Inst.C.E., M.I.Mech.E., and M.I.N.A. The burial took place at Teddington Cemetery on Wednesday.

Mr. Chas. Walker.—The death has taken place, after a short illness, of Mr. Charles Walker, who had been associated with the electricity undertaking of the Barnes (Surrey) Urban Council since its inception.

Mr. Alexander Ross.—We regret to record the death, which occurred on February 3rd suddenly, at the age of 78 years, of Mr. Alexander Ross, who was chief engineer of the Great Northern Railway from 1897 to 1911, and was president of the Institution of Civil Engineers in 1915-1916. Mr. Ross was responsible for the construction of the portion of the Piccadilly tube between Finsbury Park and the Strand.

Mr. P. P. Kipping.—It is with regret that we announce the death of Mr. Percival Philip Kipping, which took place on Sunday last at his house at Harrow. Mr. Kipping was 57 years of age, and had always been actively associated with the science of telephony. At an early stage in his career he was the proprietor of the Universal Telephone Co., which was afterwards merged into the National Telephone Co., of which concern he became traffic superintendent. Later he was employed in Glasgow, and afterwards joined the General Electric Co., Ltd., as manager of the telephone department. On the formation of the Peel-Conner Telephone Works (proprietors, the G.E.C., Ltd.), he became the secretary of this concern, and was also technical director of the Bogota Telephone Co. Mr. Kipping was a prominent Freemason, and was highly respected among his colleagues in the G.E.C. and among the whole of the electrical trade.

Mr. F. Rud-Weber.—We read in the *South African Mining and Engineering Journal* that Mr. Frek. Rud-Weber, the former chief engineer of the A.E.G. Erection Department of South Africa, died suddenly on December 3rd at Zurich in Switzerland after a short illness. "Mr. Weber, who was responsible for the erection of the large power stations on the Witwatersrand, had since his departure, erected very large works in Europe, and for the last two years was chief engineer of the Electro Bank at Zurich. . . Mr. Weber was a very clever electrical and mechanical engineer, and had a large number of friends amongst the engineers on the Rand during his five years' residence in Brakpan, Simmerpan, Rosherville, and Vereeniging."

Mr. T. J. Yeomans.—We regret to learn that Mr. T. J. Yeomans passed away suddenly on January 31st at his residence at Birmingham. Mr. Yeomans for many years represented the Conduit & Fittings Co., of London, and Messrs. Donovan & Co.; and recently the B.E. Co., of Birmingham, Messrs. Coquantin, of London, Messrs. Parsons & Sons, Ltd., and the Lodge Fittings Co., Ltd., of Birmingham.

NEW COMPANIES REGISTERED.

Gramophone Salons, Ltd. (187,370).—Private company.—Registered January 26th. Capital, £500 in £1 shares. To carry on the business of owners, manufacturers, assemblers and repairers of and dealers in gramophones, phonographs and records, wireless telegraphy and telephony, &c. The first directors are: Miss Vera Howard, 15, Woodstock Road, Golders Green, N.W.11; J. N. Byrne, 7, Windsor Road, Boscombe, Bournemouth, engineer. No qualification necessary. Remuneration as fixed by the company. Secretary: J. N. Byrne. Solicitors: Lovell and White, 5, Thavies Inn, E.C.1.

Valvcryst, Ltd. (187,485).—Private company. Registered January 31st. Capital, £300 in £1 shares. To carry on the business of manufacturers of apparatus for wireless telephones and electrical fittings of all kinds, electricians, mechanical, electrical and general engineers, &c. The subscribers (each with one share) are: K. T. Key, Beacon Cottage, Rednal, near Birmingham, jeweller; J. T. Holmes, Trevosa, Thornhill Road, Streetley, Staffs., jeweller. The first directors are not named. Registered office: 51, Hockley Hill, Birmingham.

Aberdeen Radio Co., Ltd. (12,544).—Private company. Registered in Edinburgh January 31st. Capital, £1,000 in £1 shares. To carry on the business of manufacturers of and sellers of all kinds of radio apparatus and accessories for the transmission and reception of broadcast wireless messages. The subscribers (each with one share) are: W. W. Inder, 41½, Union Street, Aberdeen, wireless engineer; J. J. Breen, 41½, Union Street, Aberdeen, radio engineer. The first directors are not named. Secretary: John S. Yule.

James Ferguson and Munro, Ltd. (12,541).—Private company. Registered in Edinburgh January 27th. Capital, £3,000 in £1 shares. To carry on the business of electrical engineers and manufacturers of switches, &c. The subscribers (each with one share) are: A. Ferguson, Fernieshaw, Cleland, Lanarkshire, electrical engineer; J. Munro, Stepps Engineering Works, Stepps, Glasgow, electrical engineer. J. Munro is the first director. Qualification: £100 shares. Remuneration of managing director: £200 per annum. Secretary: J. Munro. Registered office; Stepps Engineering Works, Stepps, near Glasgow.

W. and M. Wireless Co., Ltd. (187,435).—Private company. Registered January 29th. Capital, £100 in £1 shares. To carry on the business of manufacturers of and dealers in wireless apparatus and accessories of all kinds, &c. The subscribers (each with one share) are: E. Wainwright, 44, Montalt Road, Woodford Green, Essex (director of Wainwright Manufacturing Co., Ltd.); H. A. I. Machen, 141, Victoria Road, Charlton, S.E.7 (director of Wainwright Manufacturing Co., Ltd.). The permanent directors are to be appointed by the subscribers, who may appoint themselves. Solicitors: Kenneth Brown, Baker, Baker, Lennox House, Norfolk Street, Strand, W.C.2.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Whitstable Electric Co., Ltd.—Particulars filed of £10,000 debentures authorised January 5th, 1923, charged on the company's undertaking and property, present and future, including uncalled capital (subject to £10,000 existing debentures); the amount of the present issue is £10.

Irradiant Lamp Works, Ltd.—Particulars filed of £5,000 debentures authorised January 4th, 1923, charged on the company's undertaking and property, present and future, including uncalled capital, the amount of the present issue being £3,200.

Low Engineering Co., Ltd.—Charge on the company's undertaking and property, present and future, including uncalled capital dated January 24th, 1923, to secure £1,000. Holder: N. M. Poole, 4, Farquhar Road, Wimbledon Park, S.W.19.

Newquay Electric Light and Power Co., Ltd.—Particulars filed of £8,000 debentures authorised July 25th, 1922, charged on the company's undertaking and property, present and future, including uncalled capital, the whole amount being now issued.

Watford Electric and Manufacturing Co., Ltd.—Particulars filed of £8,000 debentures authorised January 24th, 1923, charged on the company's undertaking and property, present and future, including uncalled capital, subject as to freehold property and certain fixtures thereon, to a prior mortgage for £5,000, the whole amount being now issued.

Standard Electric Sign Co., Ltd.—Mortgage dated January 5th, 1923, to secure £187 10s. now due and quarterly instalments of £93 15s., each commencing April 1st, 1923, for remainder of term of five years from October 1st, 1922, unless previously determined, charged on instalments payable under an agreement dated March 7th, 1922, between the company and Associated Newspapers, Ltd. Holders: Frank Mason & Co., Ltd., Maxwell House, Arundel Street, W.C.2.

Scott Insulated Wire Co., Ltd.—Debenture dated January 22nd, 1923, to secure £2,000, charged on the company's undertaking and property, present and future, including uncalled capital. Holders: London Nominees, Union Bank of Scotland, Ltd., 62, Cornhill, E.C.

Woking Electric Supply Co., Ltd.—Issue on January 23rd, 1923, of £600 debentures, part of a series already registered.

Wezdon Lamp Co., Ltd.—Satisfaction to the extent of £400 on January 24th, 1923, of debentures dated April 24th, 1922, securing £1,300.

Connollys' (Blackley), Ltd.—Particulars filed of £16,150 debentures and premium of £5 for each £95, authorised October 11th, 1922, charged on the company's undertaking and property, present and future, including uncalled capital (subject to £30,000 first debentures), the amount of the present issue being £2,945.

Henry Summers & Sons, Ltd.—F. B. Darke, of 146, Bishopsgate, E.C., was appointed receiver and manager by order of Court dated January 19th, 1923.

Maxim Electrical Co., Ltd.—J. F. Poynter, of 75a, Canonbury Road, N.1, ceased to act as receiver or manager on January 22nd, 1923.

Frinton-on-Sea and District Electric Light & Power Co., Ltd. (70,689).—Return dated October 25th, 1922. Capital, £10,000 in 7,300 preference and 2,700 ordinary shares of £1 each. All shares taken up. £10,000 paid. Mortgages and charges, £10,000.

Hackbridge Cable Co., Ltd. (146,684).—Return dated November 22nd, 1922. Capital, £75,000 in 50,000 preference and 25,000 ordinary shares of £1 each. 25,000 preference and 21,450 ordinary shares taken up. £26,452 paid on 25,000 preference and 1,452 ordinary shares. £19,998 considered as paid on the remainder. Mortgages and charges, £40,000.

Church Stretton Electric Supply Co., Ltd. (80,857).—Return dated August 24th, 1922. Capital, £10,000 in £1 shares. 8,754 shares taken up. £154 paid. £8,000 considered as paid. Mortgages and charges, £6,400.

Electric Welding Co., Ltd. (31,364c).—Return dated October 31st, 1922. Capital, £400,000 in 45,000 ordinary and 1,000 founders' shares of £10 each. 22,417 ordinary and 917 founders' shares taken up. £136,830 2s. 7d. has been paid on 14,084 ordinary and 917 founders' shares, leaving £13,179 17s. 5d. in arrears. £83,330 is considered as paid on 8,333 ordinary shares. Mortgages and charges, £22,400.

Pacific and European Telegraph Co., Ltd. (36,683c).—Return dated November 14th, 1922. Capital, £100,000 in £10 shares. All shares taken up. £4 per share called up. £40,000 paid. Mortgages and charges, £66,500.

St. Austell and District Electric Lighting & Power Co., Ltd. (66,382).—Return dated August 2nd, 1922. Capital, £10,000 in 3,000 preference and 7,000 ordinary shares of £1 each. 3,000 preference and 4,887 ordinary shares taken up. £7,887 paid. Mortgages and charges, £3,400.

James Keith & Blackman Co., Ltd.—Satisfaction in full on January 17th, 1923, of debentures dated November 3rd, 1902, and May 15th, 1906, securing £75 and £125 respectively.

Singapore Electric Tramways, Ltd. (84,088).—Return dated January 3rd, 1923. Capital, £100,000 in 5s. shares. All shares taken up. £100,000 considered as paid. Mortgages and charges, £271,700.

Newcastle and District Electric Lighting Co., Ltd.—Satisfaction on December 20th, 1922, (*a*) to the extent of £10,000 (whole amount secured) of fourth mortgage debenture dated March 27th, 1922, securing £10,000 and further sums not exceeding in all £20,000; and (*b*) in full of trust deed dated July 31st, 1914, securing £30,000 debentures.

Chippenham Electric Supply Co., Ltd.—Satisfaction to the extent of £800 on December 31st, 1922, of trust deed dated February 3rd, 1913, securing £2,000.

CITY NOTES.

Yorkshire Electric Power Co.

The net profit for the year 1922 was £101,004, plus £23,260 brought forward, making £124,264, against £74,316 net profit for 1921, plus £20,939 brought forward, making £95,255. The 6 per cent. preference dividend absorbs £23,529; a total of 8 per cent. for the year on the ordinary shares requires £49,196; £25,000 is to be put to reserve making it £129,000, leaving £26,538 to be carried forward. Economies effected during the year, more especially by the new generating plant installed, have resulted in a satisfactory improvement in the balance available for disposal. There has been a substantial increase in the amount of electricity sold, accompanied by a large reduction of price to customers of the company following the price of coal in terms of their agreements. New generating plant has been set to work at Barugh and a new 12,000-kW turbo-alternator is nearing completion at Thornhill. Co-ordination of supply in the company's area progresses by agreements entered into with the Corporations of Leeds and Rotherham and the Urban District Councils of Holmfirth and Mexborough. The amount of electricity supplied in bulk continues to increase, and it is satisfactory to note from published statements of local authorities that definite economies have resulted from taking a bulk supply from the company. Many new agreements have been made for the supply of electricity to power users, and important extensions of mains and sub-stations have been made. The continued growth of demand will necessitate further extensions of generating plant and mains. The Electricity Commissioners held inquiries during the year into the present and future position of electricity supply in the proposed South-East Lancashire and North-East Midlands Electricity Districts, which with the inquiry held in 1921 regarding the West Riding (Aire and Calder) Electricity District, completes the first inquiry in respect of the whole area in which the company has powers of supply. No final decision has yet been reached in any of these. In February, 1922, an issue of £558,360 six per cent. cumulative preference shares was made and considerably over-applied for. The amount of 5½ per cent. redeemable debenture stock issued has been increased to £550,000, a further £190,000 having been taken up at par in August last. On May 31st, the Yorkshire Electric Power Act, 1922, received Royal Assent by which the authorised capital of the company was increased from £2,000,000 to £4,000,000 with a corresponding increase in borrowing powers up to one-third. Under the Act each £10 ordinary and each £5 preference share became converted into ten ordinary and five preference shares of £1 each respectively. The necessary exchange of certificates is proceeding.

Annual meeting: February 20th, at Leeds.

The German Netherlands Telegraph Co.

The association for the protection of the interests of Dutch holders of shares and obligations in the *German-Netherlands Telegraph Co.* reports the absence of funds for the payment of the coupons and obligations due for redemption on January 1st, 1923. Nevertheless, the association states that it is in constant touch with the Government of Holland with the object of securing a satisfactory settlement of the claims of Dutch interests in connection with the result of the negotiations in Washington respecting the transfer to the Dutch Government of the Yap-Menado cable, which forms part, according to the Versailles Treaty of Peace, of the cable of the German-Netherlands Telegraph Co., which was seized by the Allies.

An International Holding Company.

The *Société Internationale d'Energie Hydro-Electrique* has been formed at the offices of the Société Financière de Transports, 46-48, Rue de Naples, Ixelles, Brussels, with a share capital of 90,000,000 fr. This comprises 100,000 250-fr. preference shares, 260,000 250-fr. ordinary shares, and 40,000 founder shares of no specific value. The properties transferred to the new company include (1) 60,000 preference shares of $100 in the Barcelona Traction, Light and Power Co., which have been handed over by the Société Financière, the Canadian & General Finance Co., the Guarantee Insurance & Investment Co., Sir James H. Dunn, M. Alfred Loewenstein and M. A. Mathot, in return for 30,000 fully-paid preference shares, 45,000 fully-paid ordinary shares and 9,371 founder shares; (2) 9,250 shares of $100 in the Mexico Tramways Co. in return for 9,250 fully-paid ordinary shares and 462 founders' shares, issued to the Guardian Insurance Co.; and (3) 7,250 shares of $100 in the Mexico Tramways Co. in return for the issue to M. A. Loewenstein of 7,250 fully-paid ordinary shares and 363 founders' shares. After providing by the allocation of shares for the exercise of an option on further interests in the Mexico Tramways Co., a long list of subscribers has been arranged for the balance of 70,000 preference shares and 198,500 ordinary shares, among which the remainder of the founders' shares has been divided.

Lancashire Electric Light and Power Co., Ltd.

In order to comply with Stock Exchange Regulations, an advertisement has been issued in the Press to the effect that the company recently accepted an offer of the Power Securities Corporation, Ltd., to purchase 75,000 six per cent. cumulative convertible first preference shares of £1 each at the price of 21s.; 75,000 seven per cent. cumulative participating preference shares of £1 each at 21s.; and 75,000 ordinary shares of £1 each at 20s. per share. The company has also given the Power Securities Corporation an option to purchase (up to June next) an additional 22,637 ordinary shares of £1 each at 20s.

Adelaide Electric Supply Co., Ltd.—For the year ended August 31st, 1922, the gross revenue amounted to £372,466, and operating expenses and taxes to £215,924, leaving net revenue of £156,542. After writing off cost of 7½ per cent. debenture stock issue and providing for interest and sinking funds on debentures, £124,393 remains after putting £12,142 to general reserve. The total dividend, as stated last week, is 12 per cent. for the year. £40,072 is being carried forward.

At the annual meeting of the company, held in Adelaide on December 7th last, Sir George Brookman, the chairman, said that the sales of energy were double those of 1918; the gross revenue had shown an increase of 16 per cent., and the net revenue had increased by 17 per cent. The reserves stood at £311,530.

Hong Kong Tramway Co.—The results for 1922 show a profit of $553,559 less the interim dividend $124,800. After including the balance brought forward, a final dividend of $291,589 is recommended. It is stated that at the annual meeting, to be held in Hong-Kong on April 11th, the directors of the London company will, with the dividend received from the Hong-Kong Tramways, Ltd., recommend a final dividend of 2s. per share (at 2s. 2¼d. exchange).

Kensington & Knightsbridge Electric Lighting Co., Ltd.—The directors have recommended a balance dividend of 7s. per share on the ordinary shares for the half-year ended December 31st, 1922, making, with the interim dividend, 12 per cent. for the year. A further reduction in the company's supply charges to consumers will come into operation as from the Lady Day meter readings.

City of Buenos Ayres Tramways Co., Ltd.—For the year ended December 31st, 1922, a balance dividend of 1s. 3d. per share (making 5 per cent. per annum), less tax, is to be paid, £5,000 transferred to general amortisation fund, and £9,198 carried forward.

Metropolitan Railway Co.—Dividend upon the ordinary stock for the past half-year at the rate of 4¼ per cent. per annum, making 3¼ per cent. for the year, carrying forward £33,000, after placing £57,000 to depreciation and renewals and £15,000 to general reserve.

Reduction of Capital.—"Z" Electric Lamp & Supplies Co., Ltd. and Reduced.—A petition for the confirmation of the reduction of capital from £30,000 to £26,000 has been presented to the High Court, and will be heard in London on February 16th.

Frederick Braby & Co., Ltd.—Interim dividend of 5 per cent., less tax, on the ordinary shares.

St. James's & Pall Mall Electric Light Co., Ltd.—Balance dividends for the year ended December, 1922, of 3s. 6d. per share on the preference shares and 7s. 6d. per share on the ordinary shares, with a bonus of 2s. per share, making a total of 14½ per cent. for the year.

STOCKS AND SHARES.

Tuesday Evening.

It had been generally supposed that the rupture of the negotiations at Lausanne would be followed in the Stock Exchange by a fairly general break in prices, but the expected stream of selling on behalf of the public did not materialise. After a dull opening at the beginning of the week, the markets not immediately affected by foreign politics were quick to throw off any sympathetic sentiment which, to the Stock Exchange mind, is the invariable sequel. The subsequent events confirmed the impression that the Turks are still anxious for peace, and prices, as a whole, are distinctly firm.

To get the question of the American debt settled, or partially settled, is regarded as a mild bull point, although the settlement itself does not please those who consider its terms needlessly onerous and excessive. However that may be, the effect of the various foreign news, American, German, Turkish, &c. of the week is to leave markets in a steady though somewhat quiet condition, and the dimensions of the settlement which finishes on Thursday are less than half those which characterised the account of a fortnight ago.

Dividend declarations from the electricity supply companies are up to the best expectations. One after another, the undertakings show that they deserve well of their proprietors on account of the excellent results for 1922 which are now being published. Kensingtons spurted sharply, on the dividend announcement, and Londons are another share which have come into pronounced favour, owing to favourable rumours circulated in connection with what the company is likely to do. Dealers in the market complain that they are unable to get shares to meet a demand which is more pressing than ever, and one result of the remarkable strength shown by quotations is to emphasise the desire that the shares which are not yet split into those of the denomination of £1 should be so treated at an early date.

Chelseas have risen another 10s., making 27s. 6d. in a fortnight. Westminsters are 12s. 6d. higher, St. James's gained 5s., Citys 9d., County of London 6d., while Brompton Ordinary at 33s. 6d. are 3s. 6d. better on the week. Whitehall Electric preference put on 1s. at 19s.; the debentures have risen to 90½. The market as a whole shows pronounced strength.

The Westminster dividend, making 12 per cent. for the year, is 2 per cent. better than that of the preceding twelve months. The Kensington's results are equally good, and Chelsea, as already mentioned, pays 10 per cent. for the year as against 6 per cent.

Edison-Swans at 3s. 3d. are 6d. up. English Electrics are similarly better at 17s. 3d. and Siemens regained 6d. of their previous drop, hardening to 19s. 6d. The preference shares, however, are a little dull at 25s. Callenders preference rose to 1 3/16. Brush ordinary are steady at 25s. 6d.

Amongst prices of cable stocks there is not much alteration. Great Northerns at 27 are 10s. lower. Oriental Telephones improved to 2 5/16, but the feature in this section is the buoyancy of Marconis, the shares rising to 2¾, at which price they were strongly supported. As previously mentioned, the company is said to be doing well out of the profits it is making upon the broadcasting business. The preference shares moved in sympathy. Canadian Marconis, the report in which is expected next month, have scarcely moved from 11s. 3d., interest in them being at a low ebb, and New York has been doing nothing worth mentioning in Radio Corporations.

British Columbia Electric Preference rose four points to 80½, on investment demand which recognises that 6¼ per cent. on the money from a stock of this class is liberal. The deferred gained a point at 90½, at which price the return on the money is just under 7 per cent., free of tax, equal to 9¼ per cent., taking tax at 5s. in the £. Anglo-Argentine Tramways first and second preferences came to the common level of 3½. In the London group, British Electric Traction preference put on two points at 96. Mexican Light & Power first bonds fell to 63¼, yet some of the other Mexican utilities are better. The latest rumour has it that loan negotiations between the United States and Mexico will come to a satisfactory head next month.

The Metropolitan Railway dividend of 3¼ per cent., as against 2¼ per cent. for the previous year, was scarcely up to expectation, and the price has gone back to 61. Lively interest centres in the District announcement, which, at the time of writing, is not out. Some people are looking for as much as 4 per cent. for last year, and a rise of two points in the price reflects what may appear somewhat exuberant optimism. Underground Income Bonds are better at 93½, but the "A" shares shed 1s. Business in the Tube 4½ per cent. debenture stocks continues on the basis of 94 for the scrip shares, though holders of registered stock find that in selling, they have to accept a point less than the price quoted for bearer; owing, of course, to the fact that the Inland Revenue stamp duty is 20s. per £100 money.

Rubber shares are keeping their prices, the [illegible] having hardened to 1s. 6d. per lb. There is a good deal going on amongst iron and steel issues. Bolckow Vaughan new 6 per cent. debentures, issued at 99½, started off in the market at 1½ premium. Armament shares are quieter, with comparatively little doing.

SHARE LIST OF ELECTRICAL COMPANIES.

Home Electricity Companies.

	Dividend. 1920.	1921.	Price Feb. 6, 1923.	Rise or fall.	Yield p.c.
Brompton Ordinary	12	12	33/6†	+3/6	£3 11 8
Charing Cross Ordinary	8	9	8¼	—	5 9 1
do. do. do. 4½ Pref.... ...	4½	4½	4 7/16	—	5 7 5
Chelsea	6	6	8¼	+ ½	6 3 1
City of London	14	14	45/9	+9d.	6 4 5
do. do. 6 per cent. Pref. ...	6	6	23/-	—	5 4 4
County of London	8	8	32/6	+6d.	5 0 0
do. do. 6 per cent. Pref. ...	6	6	1⅛	—	5 4 4
Edmundson's Ordinary	Nil	Nil	2½	—	Nil
do 6 per cent. Pref. ...	6/-	12/-	4⅜	+ ⅛	6 13 4
Kensington Ordinary	9	10	8½	+ ⅜	6 17 2
London Electric	2½	4	8¼	+ 1/16	3 16 2
do. do. 6 per cent. Pref. ...	6	6	5⅛	—	5 17 1
Metropolitan	7	7	5⅝	+ ⅛	5 3 8
do. 4½ per cent. Pref. ...	4½	4½	4 1/16	—	5 10 9
Newcastle-on-Tyne Ordinary	8	Nil	1/16	—	Nil
do 5 per cent. Pref. ...	5	5	15/9	—	6 7 0
do 7 per cent. Pref. ...	—	7	22/-	—	6 7 3
Notting Hill, 6 per cent. Pref.	6	6	9½	—	6 9 9
North Met. Elec., 6 per cent. Pref. ...	6	6	1 1/16	—	5 13 0
Urban Ordinary	Nil	Nil	1½	—	Nil
do 5 per cent. Pref. ...	2½	2½	4⅛	—	6 1 3
St. James' and Pall Mall	12	12	9⅝	+ ½	6 3 1
South London	7	7	4⅞	—	5 18 0
South Metropolitan Pref.	7	7	1 1/16	—	5 18 0
Westminster Ordinary	10	10	9	+ ⅜	5 11 1
Whitehall Elec. Inst., 7½ per cent. Pf.	—	7½	19/-	+1/-	7 18 0

Telegraphs and Telephones.

Anglo-Am. Tel. Pref.	6	6	103½	—	5 16 0
do. Def.	1½	34/6	22½	—	6 14 10
Chile Telephone	6	6	5⅜	—	4 16 0
Cuba Sub. Ord.	7	7	7⅞	—	9 0 8
Eastern Extension	10	10	19	—	5 5 3
Eastern Tel. Ord.	10	10	189½	—	5 5 6
Globe Tel. and T. Ord.	10	10	19	—	5 5 3
do. do. Pref.	6	6	11½	—	5 6 8
Great Northern Tel.	24	22	27	— ½	8 2 0
Indo-European	10	10	35½	—	7 1 0
Marconi...	25	15	2⅜	+ 1/16	5 14 3
Oriental Telephone Ord.	12	12	2 7/8	+ 1/16	*4 14 3
United R. Plate Tel.	8	8	7	—	*5 14 4
West India and Panama	Nil	Nil	7/6	—	Nil
Western Telegraph	10	10	18⅞	—	*5 6 8

Home Rails.

Central London Ord. Assented	4	4	68	—	5 17 8
Metropolitan	1½	2½	61	+1	3 14 9
do. District	Nil	1	49	+2	2 2 7
Underground Electric Ordinary... ...	Nil	Nil	3	— 1/16	Nil
do. do. "A"	Nil	Nil	7/-	—1/-	Nil
do. do. Income	2	4	99½	+1	*4 5 5

Home and Foreign Trams, &c.

Anglo-Arg. Trams. First Pref.	5½	12½	8½	— 1/16	7 17 2
do. do. 2nd Pref.	Nil	5½	3½	— 1/16	8 11 0
do. do. 5 per cent. Deb. ...	5	5	82	—	6 2 0
British Electric Traction Ordinary ...	4½	—	66½	—	6 15 4
do 6 per cent. Pref. ...	6	6	96	+2	6 5 0
Brazil Tractions	Nil	Nil	45	—	8 17 9
British Columbia Elec. Rly. Pce. ...	5	5	80½	+¼	6 4 5
do. do. Preferred ...	5	93/-	75½xd	+1	*6 4 0
do. do. Deferred ...	8	124/-	90½xd	+ ½	*6 18 6
do. do. Deb.	4½	4½	77½	—	5 9 8
Lond. and Sub. Trac., 5 per cent. Pf.....	2½	3½	11/6	—	6 1 9
London United Tram deb.	4	4	62½	—	6 8 0
Mexico Tram. 5 per cent. Bonds ...	Nil	Nil	78½	—	6 7 5
do. 6 per cent. Bonds ...	Nil	Nil	66½	—	Nil
Mexican Light Common...	Nil	Nil	19½	—2	Nil
do. Pref.	Nil	Nil	49½	—	Nil
do. 1st Bonds.	Nil	5	63½	—3½	7 17 6

Manufacturing Companies.

Babcock & Wilcox	15	15	8 7/16	+ 1/16	4 18 0
British Aluminium Ord.	10	5	18/3	—	5 9 7
British Insulated Ord.	15	15	9 7/16	—	6 9 10
Callenders	15	15	9 7/16	—	6 13 4
do. 6½ Pref....	6½	6½	1 7/16	+ 1/16	5 9 5
Crompton Ord.	10	5	16/3	—	6 8 1
Edison-Swan	10	Nil	3/3	+6d.	Nil.
do. do. 5 per cent. Deb.	5	5	61	—	8 1 4
Electric Construction	10	10	1⅜	—	7 5 6
English Electric	8	5	17/3	+6d.	5 16 0
do. do. Pref.	6	6	1	—	6 0 0
Gen. Elec. Pref.	6½	6½	21/9	—	5 19 6
do. Ord.	10	5	19/3	—	5 4 0
Henley	15	15	2⅜	—	6 6 4
do. 4½ Pref.	4½	4½	4⅜	—	5 2 10
India-Rubber	10	—	13/-	—	—
Met.-Vickers Pref.	8	8	2 7/16	—	6 11 2
Siemens Ord.	10	10	19/6	+6d.	Nil.
Telegraph Con.	20	20.	25⅞	—	*4 11 6

* Dividends paid free of Income Tax.
† New shares.

MARKET QUOTATIONS FOR CHEMICALS AND METALS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general and they may vary according to quantities and other circumstances

CHEMICALS, &c.	Price February 7th.	Fortnight's Inc. or dec.
a Acid, Oxalic ... ... per lb.	6¾d.	¼d. dec.
a Ammoniac, Sal ... ... per ton	£63	...
a Ammonia, Muriate (large crystal) ,,	£48	...
a Bisulphide of Carbon ... ... ,,	...	...
a Borax... ... ... ,,	£28	...
a Copper Sulphate ... ... ,,	£26 15s.	...
a Potash, Chlorate ... ... per lb.	4d. to 4¼d.	...
a ,, Perchlorate ... ... ,,	6½d.	...
a Shellac ... ... per cwt.	£19	...
a Sulphur, Sublimed Flowers ... ,,	£9	...
a ,, Lump ... ... ,,	£8 10s.	12/6 dec.
a Soda, Chlorate ... ... per lb.	3¾d.	...
a ,, Crystals ... ... per ton	£6	...
a Sodium Bichromate, casks ... per lb.	4¼d.	¼d. dec.
METALS, &c.		
b Aluminium, Ingots... ... ... per ton	£100	...
b ,, Wire ... ... per lb.	1/9 to 2/6	...
b ,, Sheet ... ... ,,	1/6 to 2/-	...
p Babbitt's Metal and Anti-friction Metal—		
Grade I ... ... per ton net	£172	£4 inc.
Grade II ... ... ,, ,,	£126	£2 inc.
Grade III ... ... ,, ,,	£71	£3 inc.
c Brass (rolled metal 2' to 12' basis) per lb.	9¼d.	¼d. inc.
c ,, Tubes (solid drawn) ,, ,,	1/- to 1/0½d.	¼d. inc.
c ,, Wire, basis ... ... ,,	10½d.	¼d. inc.
c Copper Tubes (solid drawn) ... ,,	1/1½	¼d. inc.
c ,, Bars (best selected) ... per ton	£98	£2 inc.
c ,, Sheet ... ... ,,	£98	£2 inc.
c ,, Rod ... ... ,,	£98	£2 inc.
d ,, (Electrolytic) Bars ... ,,	£72 10s.	35/- inc.
d ,, ,, Sheets ... ,,	£145 10s.	...
d ,, ,, Wire Rods ,,	£82 10s.	35/- inc.
d ,, ,, H.C. Wire per lb.	10¾d.	¼d. inc.
f Ebonite Rod ... ... ,,	3/6	...
f ,, Sheet ... ... ,,	3/-	...
n German Silver Wire ... ... ,,	2/6	...
h Gutta-percha, fine ... ... ,,	12/6	...
h India-rubber, Para fine ... ... ,,	1/5	1d. dec.
l Iron Pig (Cleveland Warrants) ... per ton	92s. 6d.	...
l ,, Wire, galv. No. 8, P.O. qual. ,,	£24	...
g Lead, English Pig ... ... ,,	£29 5s.	10/- inc.
g Mercury ... ... per bot.	£10 7/6d. to £10 10/	10/- to 12/6. dc.
e Mica (in original cases) small ... per lb.	3d. to 3/-	...
e ,, ,, medium ... ,,	4/- to 8/-	...
e ,, ,, large ... ,,	10/- to 20/- & up.	...
p Phosphor Bronze, plain castings ,,	1/1½	¼d. inc.
p ,, drawn bars and rods ,,	1/3½	¼d. inc.
p ,, rolled strip & sheet ,,	1/2½	¼d. inc.
p ,, wire ... ... ,,	1/4	¼d. inc.
o Platinum ... ... per oz.	£25	...
d Silicium Bronze Wire ... ... per lb.	1/0½	¼d. inc.
r Steel, Magnet, in bars ... ... ,,	10d.	...
n Tin, Block (English) ... ... per ton	£183 10s. to £184	...
n ,, Wire, Nos. 1 to 16 ... ... per lb.	3/2	...

Quotations supplied by

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
l Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p C. Clifford & Son, Ltd.
r W. F. Dennis & Co.

Indian Water Power.—Lecturing to the Indian Science Congress on hydro-electric problems, Lieut-Col. B. Battye said that the coal age all over the world was rapidly drawing to a close, and especially in India whose resources in steam coal would, at the present rate of consumption, be entirely used up in 70 or 80 years. The future economic stability of the country entirely depended upon development of water-power, and in Northern India that hinged upon the development of the Himalayan rivers. Available markets for power in Northern India were not as yet sufficiently concentrated to justify the development of separate projects for each industrial area unless the rivers could be devoloped by using the comparatively expensive low falls available. This left two alternatives—either the development of large national projects, serving thirty or more towns, entailing widespread transmission, large initial capital and consequently nationalisation—or else the adoption of low-fall schemes in each locality.

Hydro-electrical development problems in India were in the main administrative and political rather than technical. Large amounts of capital such as at present appeared to be beyond the resources of the provinces would have to be found and this could only be got by resort to western capitalists, who would be prepared to find the capital only if a safe return was guaranteed.—*Reuter* (Lucknow).

Trials of Electric Vehicles in France.—With the object of giving an impetus to the use of electric motor vehicles in France, the Union des Syndicats de l'Electricité, of 25 Boulevard Malesherbes, Paris, in connection with the French Automobile Club and the Society of French Motor Manufacturers, proposes to organise a reliability trial of all classes of electric vehicles—both for pleasure and industrial purposes—from September 15th to 30th next. The trial is, we understand, to be restricted to vehicles of French manufacture.

THE MAGNETRON.

In view of the reference by Dr. Langmuir to the use of the "magnetron," for the control of thermionic currents of large power, in the lectures which were abstracted in our issue of January 26th (p. 132), the following account of this type of valve may be of interest. It is based upon a lecture delivered by Mr. A. W. Hull before the American Institute of Electrical Engineers (*Journal* A.I.E.E., September, 1921). Dr. Langmuir stated that a 1,000-kW magnetron was in process of development:—

The "magnetron" is a vacuum electric device which is controlled by magnetic field. It belongs to the "kenotron" family of vacuum thermionic devices.

Structurally, the magnetron is a simple kenotron whose elements are symmetrical about an axis. It may consist of a straight filament surrounded by a cylindrical anode, a straight rod-shaped anode, surrounded by a helical filament, or it may have three elements—a filament, grid, and anode,

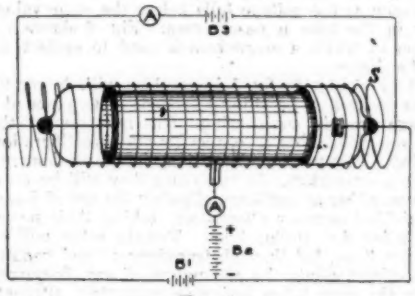

Fig. 1.

all symmetrical with respect to a common axis. Circular symmetry with respect to an axis is essential; the fundamental distinguishing structural feature of the magnetron is its symmetry.

A second essential structural characteristic is that it should be of such form that a magnetic field parallel to the axis can be conveniently and economically applied. The glass envelope is a tight-fitting cylinder, concentric with the electrodes, so that a solenoidal coil may be wound directly on the glass; and the anode is slotted longitudinally, so that the magnetic flux produced by the solenoid will not be neutralised by eddy currents.

Electrically, the magnetron is a valve, operated by magnetic field. If a constant voltage is impressed between cathode and anode, the current that flows through the tube is not affected by a magnetic field weaker than a certain critical value, but falls to zero if the field is increased beyond this value. The magnetic field must have its lines parallel to the axis of the tube.

Fig. 1 shows the tube and circuit. The cathode is a straight tungsten filament, the anode a circular cylinder. A battery, E_1, heats the filament to incandescence, and another battery, E_2, impresses a constant voltage between cathode and anode, the anode being positive. This is a plain kenotron arrangement, and if the temperature of the filament is high enough, a current will flow across the vacuum. The magnitude of the current will be limited either by the temperature of the filament or the voltage of the anode, whichever gives the smaller value of current.

The addition of a magnetic field, produced by the solenoid S, imposes a third type of limitation upon the current flow. If the field is weaker than a certain critical value, the full current will flow, limited only by filament temperature or voltage; if the field is stronger than this critical value, no current will flow. The action is similar to that of a relay. The magnetron relay has the advantage of no moving parts and no inertia—its speed is limited only by the time necessary to build up the magnetic field, which may easily be made less than one millionth of a second. It has the disadvantage that it is a high-resistance relay, since it requires a vacuum tube in the circuit.

A typical gauss-ampere characteristic is shown in fig. 2.

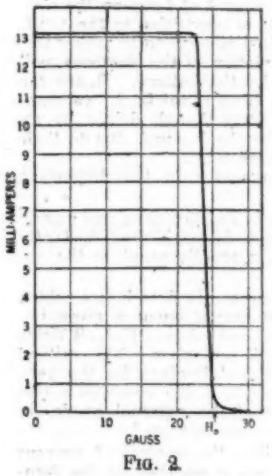

Fig. 2.

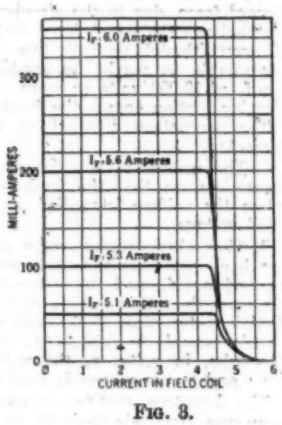

Fig. 3.

The abscissæ are gausses, or lines per cm.^{2}, the ordinates current through the tube. The anode was a cylinder 1¼ in. in diameter and 4¼ in. long, the cathode a 4-mil straight filament. It is seen that for all values of the magnetic field less than 23 lines per cm.^{2}, the valve is wide open, and the same current flows through the tube as when the magnetic field is zero. For fields larger than 25 lines per cm.^{2} the valve is closed, and no current flows. It will be noted that the transition from "open" to "closed" condition is not quite abrupt. This is due mainly to lack of symmetry. In a well evacuated perfectly symmetrical tube, the transition should be very nearly abrupt.

In fig. 2 the maximum current is limited by the voltage between cathode and anode. The effect of the magnetic field is the same, however, whether the maximum current is limited by voltage or temperature. This is shown in fig. 3,

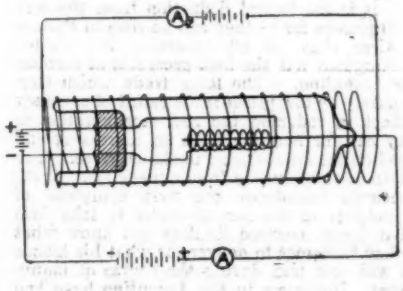

Fig. 4.

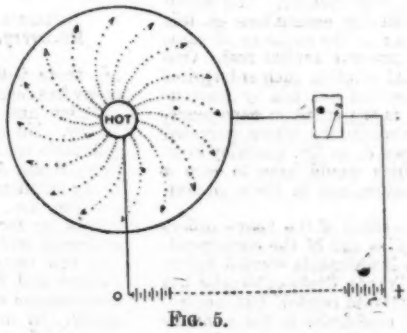

Fig. 5.

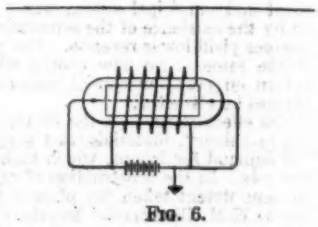

Fig. 6.

which gives the characteristics of the same tube at four different filament temperatures. In the upper curve the temperature is high enough so that the current is limited only by the voltage. In the other three, the current is limited by the filament temperature.

The critical value of magnetic field that is just sufficient to close the valve depends only upon the diameter of the anode and the voltage across the tube. It is inversely proportional to anode diameter, and directly proportional to the square root of the voltage between cathode and anode. A current of 100 A at 9,000 V was reduced to a few milliamperes by the magnetic field alone.

A more sensitive form of magnetron may be made by putting the anode inside the cathode instead of outside. The tube and circuit are shown in fig. 4. The cathode is a helical tungsten filament, ¼ in. in diameter, the anode a straight tung-

sten wire 0.01 in. in diameter. The magnetic field required to operate a magnetron with internal anode is smaller than for an external anode of the same dimensions by a factor equal to the ratio of the diameters of the cathode and anode. In the tube shown in fig. 4 this ratio is 25, so that the field required to close the valve is only 1/25 as great as for a tube of similar dimensions with external anode; *i.e.*, a tube with a 10-mil straight filament surrounded by a ¼-in. diameter anode. The cut-off is less abrupt, however, in the internal anode tube.

The magnetron is closely analogous to a direct-current motor running without load. It is shown in cross-section in fig. 5. The electrons that start to move radially outward, under the influence of the impressed e.m.f., are acted on by a tangential force tending to curve their paths into spirals, and the tangential component of velocity thus imparted reacts with the magnetic field (which is normal to the plane of the figure) to produce a radial component of force on the electrons, inward toward the filament, in opposition to the e.m.f. of the battery. If the magnetic field is sufficiently strong this inward force, due to the circular motion of the electrons, will just balance the e.m.f. impressed by the battery. Hence the electrons, though perfectly free to move about in the vacuum, are unable to reach the anode, even though driven by an e.m.f. of 10,000 volts or more. The back e.m.f. due to their circular motion equals the impressed e.m.f.

The magnetron differs from the motor in two important respects:

1. The motion of the electrons is resistanceless and nearly inertialess, so that the back e.m.f. is established instantly when the voltage is applied, and is exactly equal to the applied voltage.

2. There is a critical value of magnetic field below which the back e.m.f. in the magnetron cannot equal a given impressed e.m.f., and the valve will not close. For all fields stronger than this critical value, it will close. This critical field is a function of the voltage, and is given by the very simple formula $H=6.72\sqrt{v}/R$, where v is the potential across the tube, in volts; R, the radius of the external anode, in cm.; and H the magnetic field in lines per cm.²

The kenotron rectifier exemplifies the control of current from one metal electrode in vacuum to another by the temperature of the electrodes.

Tungsten gives an emission of hundreds of amperes per sq. cm. at its melting point, and a large filament will run for years at a temperature that gives an emission of 1 ampere per cm.², or 10,000 amperes per square meter of filament surface. For example, a filament one-quarter inch in diameter and four feet long will operate continuously for years with an emission of 225 amperes, and will operate intermittently with an emission of several thousand amperes. It is thus evident that the kenotron is capable of rectifying very large currents at high voltages.

The magnetron has been used as a "synchronous detector" in continuous-wave radio-telegraphy, in the transoceanic receiving stations of the Radio Corporation. In this case the magnetron acts as a simple high-frequency valve, opened and closed at approximately signal frequency by a locally generated magnetic field, letting through first the positive peaks of the signal and then the negative, and giving an audible tone.

It can be used as an amplifier, the current to be amplified being used to energise the magnetic field, and the output circuit being in series with the tube and battery; and as a generator of high-frequency alternating current.

One of its applications is to lightning and surge arresters. The magnetron is connected in multiple with the machine to be protected, and the magnetic field is adjusted so that no current flows through the magnetron under normal conditions. If the voltage rises above normal, however, as soon as it reaches a definite predetermined excess the magnetron valve opens wide, allowing a very large current to flow, but closes again as soon as the voltage falls below the same value. The time lag in the tube is nearly zero. Fig. 6 shows a simple application in which a magnetron is used to protect a high-voltage d.c. line.

"The tube shown in fig. 1 is capable, with larger filament and water cooling, of handling hundreds of amperes at almost any voltage used in engineering. One may predict that one year will see these tubes in use as kenotron rectifiers for series arc lighting. Five years will see them in sub-stations replacing synchronous converters. In ten years they will be on electric locomotives, either as rectifiers, allowing the use of d.c. motors, or as variable-frequency alternators, taking their power from a high-tension d.c. trolley line. Twenty years will see d.c. transmission lines, fed through transformers and kenotrons, at any convenient points, by alternators of any frequency, and tapped by the same tubes acting as magnetron alternators, or some equivalent pliotron or combination vacuum-tube alternator. The power capacity of tubes is ample for these purposes. Electron devices are not small inherently; they are only young."

BRITAIN'S PROSPECTS IN ARGENTINA.

"No private capital, either foreign or local, has ventured since 1914 to undertake extensions or new schemes connected with railways, navigation, light and power, tramways, telephones, port improvements, waterworks and drainage schemes." Such is the significant and categorical statement made, regarding the Argentine Republic, by H.M. Commercial Secretary at Buenos Aires (Mr. H. O. Chalkley) in his recent report on financial and economic conditions in that country. The reason he gives is the simple one that existing enterprises of this nature do not offer an attractive, nor in the majority of cases even a remunerative, return on a pre-war capital cost. One cannot but agree that it is immaterial whether such enterprises are prevented from increasing rates and charges by Government and municipal action, which is the common experience, or by the existence of the economic conditions where increased charges yield lower revenue. The result, as Mr. Chalkley says, is the same. No new capital which would have to earn a return on post-war cost of construction can in these circumstances be attracted.

The effect on trade is the disappearance of the heavy orders for machinery, materials, and supplies and of the corresponding demand for labour, which such investments created before the war. In the construction of railroads, State enterprise has to some extent taken the place of private capital, but, according to H.M. Commercial Secretary, confidence in the commercial future of these undertakings is not great.

It is not clear, however, that the Commercial Secretary desires to discourage British manufacturers from making offers to supply the necessary railway material. It seems unnecessary to do so, for it would be sufficient safeguard if the supplier insisted on payments in cash. Then it would not concern him if the State had to wait until some future date before a return was shown on the outlay. No doubt if British houses do not bid for the business, American or Belgian firms will.

Indeed in a section of the report which deals with foreign competition, the Commercial Secretary says that the basis of competition for the Argentine market in products and manufactures which the United Kingdom can supply is broadening out from the position of recent years, when the United States and the United Kingdom were practically the sole competitors. Not only has competition on a large scale from Germany been renewed, but Belgium also has largely increased her trade, while Spain, France, Italy, and Japan are in competition with British goods in many varieties of products. Moreover, many classes of goods are now made locally which were normally imported before the war. This local competition appears likely to continue. It is especially marked in comparison with the pre-war period in boots and shoes, clothing, furniture, provisions and beverages, leather goods, electrical fittings, ornamental ironwork, soap and perfumes, glass and cement.

Britain's Recovery.

It is the logical deduction from the conditions as far as they can be seen in Buenos Aires that, of all countries, the United Kingdom has the best prospects of increasing trade with the Argentine. The large trade which Germany has regained purely by low prices is the result of currency inflation and its effect in reducing the real remuneration of labour. No country can for long maintain an increasing and profitable trade based on an inflated and unstable currency, as every South American country knows from experience. Eventually financial insecurity introduces the first symptom of collapse, *i.e.*, the inability of the manufacturer to take firm orders for forward delivery, because he does not know what exchange will be when he comes to deliver, or what his labour and raw materials will cost him during the course of manufacture and shipment. Importers in the Argentine have had considerable experience of the uncertainty of dealing with Germany. In many cases shipments were not made until after repeated increases of prices, in some not at all, and in others importers who had covered payment against shipments not effected had to dispose of their exchange subsequently at heavy loss. Practically no business is now done in marks, all quotations being in Argentine currency. These difficulties would be considerably greater if it were not for the assistance of German merchant houses and branches in Buenos Aires, who are well versed in competitive prices and conditions, and are willing to take the speculative risk of doing business in Argentine currency without having firm prices from Germany. While accentuated in the case of Germany, the same conditions apply in a less degree to other competing European countries with inflated and depreciated currencies, and their effect must be to give prices an upward and uncertain tendency, in the measure as the cost of labour overtakes the proportion of depreciation.

Turning to the United States, the tariff there creates obstacles to the expansion of the United States export trade, by the usual effects on exchange and return freight rates, and

in raising prices on goods for export in competition with other countries.

Competition. An incentive to fresh effort should be found in the Commercial Secretary's assertion that "Once British prices become competitive with those of other countries, by reduction in cost of production, by increases in competitors' prices, or by the combined process, every other consideration—qualities, methods, deliveries, local connections—is in favour of British trade."

Amongst the branches of the Argentine import trade, in which there is little likelihood at present of the United States losing ground to competitive countries, Mr. Chalkley mentions boot and shoe factory machinery, agricultural machinery, and kinematograph material. In coal, galvanised sheets, wire, and tinplate, however, she has lost ground to the United Kingdom; in iron and steel products to Belgium and Germany; and in hardware to Scandinavia.

A Charge Refuted. Mr. Chalkley acquits the British manufacturer of the charge which is made against him that he is indifferent to chances overseas.

Statements, he remarks, continually appear in the United Kingdom to the effect that great opportunities are waiting for British manufacturers in South America which are lost by their neglect, their failure to study local requirements, their unwillingness to engage in more extensive propaganda and advertising, and particularly their alleged refusal to grant the same credits and conditions of payment as their competitors. With exceptions of relatively minor effect on the aggregate of British trade, H.M. Trade Commissioner says such statements are incorrect with regard to the Argentine; the trade of competitors in manufactures and products which the United Kingdom could also supply is in the main secured on prices, including freights, and there is no purpose in seeking for other causes and remedies.

The Iguazú Falls. With regard to the proposal to utilise for power purposes the Iguazú Falls, which are about 1,200 km. from Buenos Aires, an agreement is nearing conclusion between Argentine and Brazil to facilitate subsequent realisation of the scheme. There is no present prospect of actual construction. Similar proposals to utilise the Salto Grande falls of the River Uruguay are in abeyance. The Provincial Government of Mendoza has asked for legislative authority to grant a concession, after calling for public tenders, for the utilisation of the Nihuil Falls of the River Atuel. The Provincial Government states that several applications have been received for such a concession, but that it is thought desirable to obtain competitive proposals from foreign firms.

THE DEVELOPMENT OF THE DOMESTIC LOAD.

Yet another branch of the sales side of the electrical industry was dealt with in the Electrical Development Association lecture on February 2nd, by Mr. Davidson (Borough Electrical Engineer at Barnes), *viz.*, pushing the sales of portable accessories, such as irons, fans, small cookers, &c. Mr. H. Marryat presided.

Mr. Davidson took his own area as an example to show the field that is awaiting attack in this connection, and indicated some of the methods which he is taking to attain the desired end. For instance, there is one street of 140 maisonettes in Barnes, all of which are fitted for electricity, but the revenue from them is only £250 per annum, whereas the gas company, which has installed gas cookers and many fires, draws £1,000 from the same tenants. In the district as a whole there are 10,000 houses, 5,000 electricity consumers, 9,500 gas consumers, 100 electric cookers, 9,000 gas cookers, 1,600 electric irons, 1,200 electric fires, and 8,000 gas fires. The disparity in the figures is obvious. There is also 250 kW of small electrical apparatus installed; the charge for electricity for heating and cooking is from 1d. to 1½d. per kWh, and the price of gas is 5s. per thousand cubic feet.

Mr. Davidson did not hesitate to be very frank about the attitude of many supply engineers, whose inactivity, he said, was very marked in the residential areas where the cooking and heating load was all important. There should be distribution of suitable literature and demonstrations and exhibitions; moreover, to make electric cooking attractive, a tariff not in excess of one penny per kWh must be made standard. Thirteen years ago the Norwich system was adopted at Barnes, and in almost every instance it was effective in increasing the demand of the consumer threefold.

It would be an advantage to the supply authority and the consumer, said Mr. Davidson, if instead of discounts being allowed, the supply authority was to hand out small apparatus, such as irons, toasters, bed-warmers, curling tongs, heaters, &c., to the consumers when they paid their accounts, although he foresaw that such a policy might not meet with the concurrence of the contractors. Nevertheless, it would keep the whole of the money within the industry and practically reinvest the profits in the undertaking.

A novel and ingenious method of propaganda was adopted by Mr. Davidson. He engaged a young couple to go house hunting during week-ends, interviewing the speculative builder, admiring the house, pointing out its beauties, and winding up with telling him that had the house been fitted for electric light it would have complied with their requirements. As a point to builders Mr. Davidson urged that the bedroom fireplace could well be dispensed with and its expense saved; such fires were used very infrequently, and an electric fire was much more serviceable and economical. As an instance of the value of the accessory load it was pointed out that the addition of 3,000 flat irons in any district, with electricity at 1½d. per kWh—assuming an average consumption of 80 kWh per annum—would bring in a revenue of £1,500. Mr. Davidson believed such a result could be obtained if the irons were sent round in a van and left with householders on a sale or return basis. Similarly, a host of other small accessories should be distributed, as the introduction of such appliances was the forerunner of the complete electrical equipment of the kitchen. It was suggested that in the ideal electric kitchen each saucepan should be fitted with a self-contained heating element, notwithstanding the objections, which Mr. Davidson did not think insurmountable. Again, hot water should be procured by the installation of a moderate-size tank with a system of series-parallel control arranged for water to be boiled at various speeds, the lowest to be used for night boiling. There was no need for the apparatus to be of "window-case" finish, and manufacturers should concentrate on reducing costs, even if the articles as a result merely looked more serviceable. On the other hand, great care should be exercised in hiring such appliances as washing machines, where the cost of the apparatus was out of all proportion to the amount of electricity used. On the general question of hiring, it was stated that the prevailing feeling was that it would be suicidal for supply authorities to undertake this on any large scale until apparatus was more standardised.

After a few general remarks with regard to salesmen, it was suggested that it would be advisable to set up in every town a central showroom on co-operative lines, the supply authority being responsible for the premises; the policy would be dictated by a committee of contractors, the cost of upkeep of the showroom being met out of a proportion of the discount allowed on goods sold through the showroom. In large towns it would be a profitable departure to institute demonstration vans, by means of which domestic apparatus could be brought to the door of the consumer for test, trial, and sale.

Discussion.

The Chairman emphasised the great importance of collective advertising, through the E.D.A. or some such organisation which did not bear the stamp of a particular manufacturer or retailer. At present it was not a paying proposition to push apparatus with regard to people not already willing to buy, and who had to be persuaded to do so.

Mr. W. A. Gillott suggested that from the figures given by Mr. Davidson with regard to the Barnes undertaking the results were very small, and if a proper hiring policy were adopted in Mr. Davidson's district he would surely double his 4,000,000 kWh in a couple of years. With electricity at 1d. and 1½d. and gas at 5s. there must be something wrong there. Some twelve years ago he went round a district in a motor car dropping irons at people's houses, a scheme that was very effective. A specification for a standard cooker had been drawn up by a committee, and one manufacturer had decided to make 200, but the very people who sat on the committee would not buy the standard cooker. As to cost of laying mains, the domestic load had proved to be profitable, and he had found that 1 kW of maximum demand on the station gave a return of 3,000 kWh.

Mr. W. R. Rawlings referred to the difficulty in the application of domestic apparatus to the average house already wired. He believed the day would come when they would revert more or less to the old system of applying a fuse to each point where the domestic apparatus was to be used. The wiring would be modified when the new I.E.E. rules came into force, but they did not go far enough. A house to-day should be wired with a safety factor on heating alone that would make every circuit capable of carrying 20 amps. If each point then had a fuse capable of protecting the apparatus connected to it the system would be perfectly safe and economical. If they demanded, as to-day, that circuits must not carry more than 3 amps. at 200 volts, and if they wished more than one point to be connected to it, they were adding to the cost of wiring and putting a veto on the application of domestic apparatus. He suggested the E.D.A. should advertise to make clear to the public that there was heat in electricity, becaus

the public had it in mind that there was none. Supply authorities would profit most by the E.D.A.'s efforts, and why they could not subscribe more to the E.D.A. he knew not; supply authorities could do much more than they were doing.

Mr. L. L. Robinson (Borough Electrical Engineer, Hackney) said the object of municipal undertakings was not to make money, but to supply electricity as cheaply as possible. Who would benefit more than the contractor, who made his 25 or 33 per cent. out of the job, while municipal undertakings sold at cost? It was no good worrying the E.D.A. to do more unless contractors and supply authorities found more money. His experience was that the contractor was a broken reed to rely on.

Mr. Nobbs said quite a lot of business could be done with 1,000 watts for heating water. From an analysis of station particulars it appeared that the average station engineer was content with a 15 per cent. load factor. That seemed strange when a water-heating proposition, which need not come on the peak at all, would give a load factor approaching 60 per cent. Mr. Bowden, of Poplar, had suggested that water could be heated by turning off-peak "juice" into water storage, and it could be given at almost fuel costs. With 500 watts they could get 50 gallons of hot water per day working on a 24-hour load factor, and that was the average amount for a family of four or five.

Mr. J. W. Beauchamp (director E.D.A.) said it was generally assumed that water heating was the worst proposition before them, but he considered they would actually find their salvation in hot water. The apparatus was extraordinarily simple; an element was used which was comparatively cool, and without inconveniencing the consumer the supply authority could cut the electricity off at the peak. If they went to Mr. Davidson with about 1,000 kW of off-peak water heating load he would probably cut his 1½d. in half.

The Chairman said Mr. Robinson's argument was based on a fundamental fallacy. He might well be proud of his magnificent enterprise in his district, but would he be so enterprising if he had nothing behind him but his few thousands of pounds of personal capital and was asked to sell electrical accessories in London, to open a showroom at a rent between £400 and £2,000 a year, stock it and sell the stuff?

(A Voice: "And pay for the 'juice.'")

The Chairman: Yes, at full rates.

Mr. Robinson said the trouble was that there were too many too small contractors, particularly in London. They should form themselves into big companies, with big capital. They were too small in their ideas, too small in their money, and too slow in their operations.

Mr. Morton (Sun Electrical Co.) said the practice suggested by Mr. Davidson of giving small accessories as a bonus instead of a rebate was dangerous, because it was taking away the bread from a contractor. As to cost of apparatus, selling expenses were heavy, and a large number of discounts had to be given. Stores which were most successful were those which had never attempted to cheapen their goods, because the higher-priced goods were of better quality and were more economical. He had proved in the showrooms that it was as easy to sell a 25s. iron as a guinea one, and if things were too cheap customers were sceptical. He referred to the case of a customer whose order was £50 less than it might have been but for the negative arguments of her contractor.

Mr. Gamble (North Metropolitan Electric Supply Co.) referred to the damage which was done to the industry through some large stores selling cheap foreign apparatus, and suggested that the E.D.A. should point out to them the damage they were doing.

Mr. Scott (Admiralty) also emphasised this point.

The Chairman said the E.D.A. would like to know whether electrical apparatus should be highly finished or fairly rough.

Mr. Rawlings favoured the well-finished article. Gas apparatus was far superior to electrical apparatus in finish and detail. Manufacturers did not know what the public wanted, and did not take the trouble to find out. He had brought objections to the notice of manufacturers, and had asked them to make alterations, but they said they could not alter their standards.

Mr. Gillott said that Mr. Rawlings was not playing the game. A decent British article was a sound proposition, and the present-day standard of electric cooking apparatus was far better than that of gas apparatus. He agreed that finish should be good.

Mr. Robinson said Mr. Rawlings had put up the typical song of the British contractor, and had blamed everybody but the contractor. As to asking manufacturers to alter their apparatus, Mr. Rawlings's persuasive powers must have been extraordinarily weak, or else his ideas had not been of such a practical nature that the manufacturers could adopt them. One maker had, at Mr. Robinson's suggestions, altered his designs three times.

Mr. Howell (Hotpoint) defended the bowl fire, which had been called a "selfish" heater. One did not want to light a 3-kW fire during breakfast; a bowl fire would be sufficient. There might be a casualty list prepared shortly of people killed by gas, but not once had he seen an advertisement in the public Press telling people that electricity was a safe, clean, and healthy substitute. They needed national advertising on a large scale.

Mr. Watts urged that as soon as consumers had lighting installations they should be approached with regard to the use of electric irons, and other apparatus would follow. Supply authorities should hire them out, and push them as a "stunt."

Mr. Gamble (North Metropolitan Electric Supply Co.) said that at the conclusion of each wiring contract he sent an iron for seven days' free trial, and eight irons out of every ten were retained. This had also been done with kettles, and five out of every ten were retained.

Mrs. Walker (North Metropolitan Electric Supply Co.) emphasised the need for periodical demonstrations of cookers in showrooms, not necessarily every week, but at times when many people were in and out. She used an electric cooker; it was the cleanest she had ever used, and one could not imagine a better finished cooker.

Mr. Robinson said they should push the cooker first, which was *the* proposition, not irons. At an exhibition he had offered three months' free trial of 60 cookers and only five had come back. He had made it a condition, however, that he should have a testimonial signed by the consumer and the testimonials were distributed, so that prospective users could see who were using them in the district.

Mr. Scott (Admiralty) said electric cookers were installed at dockyards and cooked for 300 or 400 men, who were most keen about them. They saved much labour and fuss, and if taken away there would be a tumult.

Mr. Davidson, in reply, suggested that in a small area, with an average rateable value of about £36 a year, 400 kWh per consumer was not bad. His undertaking was now prepared to hire out cookers. The announcement was made last month and there had been 250 applications for hire of cookers at 7s. 6d. per quarter. His undertaking was prepared to guarantee that if any consumer would do the whole of his cooking, his occasional heating, and the whole of his lighting by electricity, it would supply him, all in, at 1½d. per kWh. In spite of that he anticipated a profit of £15,000 this year, and the overall price should not exceed 2½d. per kWh. The finish of gas apparatus had improved in consequence of the example shown by electrical people. How many cookers had Mr. Robinson sold since he commenced his campaign?

Mr. Robinson could not give the number exactly; they were going at the rate of about seven per week, and he believed he had disposed of between 200 and 300.

THE PHYSICAL SOCIETY OF LONDON.

EXHIBITION OF SCIENTIFIC INSTRUMENTS.

(*Concluded from page* 191).

Weston Electrical Instrument Co., Ltd.

Amongst the many highly-accurate instruments shown by this firm was a new series of round a.c. and d.c. switchboard instruments, also new designs of small portable a.c. ammeters, voltmeters, and wattmeters. In a new line of a.c. milliammeters having a range of 75 mA and upwards for the full-scale deflection the resistance of the lowest range is 211 ohms. A multi-range current transformer was also on view which weighed only 6¼ lb. It had three primary ranges—10, 20 and 40 A.—the secondary having a range of 5 A. The transformer core has an opening through which one turn of the primary gives a range of 800 A, two turns 400 A, and so on. The instrument is wood cased.

Foster Instrument Co.

On this stand the operation of an inspector's outfit, comprising a fixed-focus combination of radiation and thermocouple pyrometer in a convenient portable form was demonstrated, as was also a device for recording two temperatures on one chart, which employs a commutator embodying sealed mercury contacts, for which a patent has been applied for. The apparatus is particularly useful where two temperatures that are industrially related have to be recorded, as, for instance, flue temperatures on either side of an economiser. The Foster alarm recorder has an attachment whereby a buzzer, bell, or other signal is operated to call attention to the fact that a given temperature limit has been exceeded. The same type of apparatus may be employed for automatic "shut down" to provide safety control.

Messrs. Elliott Brothers (London), Ltd.

Amongst the many instruments displayed by this firm was a "multiversal" testing set that was originally designed for the mains engineer, and has been developed until it forms a universal testing set. It consists primarily of a sensitive pivoted D'Arsonval galvanometer with shunts for varying the sensibility, together with a number of coils giving from 0 to 110 ohms by steps of 1 ohm (an infinity plug being provided), coupled up in conjunction with two ratio arms to form a Wheatstone bridge, each arm consisting of four coils—1,000, 100, 10 and 1 ohms. An additional external dial can be provided to extend the range of measurement. A resistance of 100,000 ohms and a three-way switch is also provided for taking the "constant" of the galvanometer and making insulation tests. By means of a universal shunt five sensibilities are given to the galvanometer. A key is provided for the insulation portion of the apparatus, and a double successive key, that breaks both galvanometer and battery circuits, for the bridge part. The whole is mounted on ebonite in a varnished teak case with a carrying handle, and a 3-ft. tripod is provided, on to which the set can be screwed when in use. It is adapted to the following measurements:—

1. Insulation resistance (with 100-volt battery, insulation up to 100 megohms can be measured and with a 500-volt battery up to 500 megohms by the direct deflection method).
2. Conductor resistance from 0.001 ohm to 110,000 ohms.
3. Localisation of a fault to earth in the insulation of a cable, by means of Murray's loop test.
4. Localisation of a fault to earth in the insulation of a cable, by means of Varley's loop test.
5. Voltage from about 0.00075 volt up to 1,200 or 1,500 volts.
6. Milliamperes.
7. Galvanometer can be used separately from the rest of the apparatus.
8. Current of any magnitude by the addition of standard resistances.
9. Low resistances by reading the drop in voltage when a known current is passing.
10. Capacity by the addition of a standard condenser.

Goodwin Manufacturing Co.

The Goodwin Manufacturing Co. had a show case containing scientific instruments (electrical), wire, insulating materials, &c.

Concordia Electric Wire Co., Ltd.

The Concordia Electric Wire Co., Ltd., also had a glass show case containing various types of wire insulated in different manners, as well as insulating materials.

Messrs. Siemens Brothers & Co., Ltd.

Messrs. Siemens Brothers confined their exhibits to temperature indicators and recorders, of various types. Amongst these was a potentiometer for measuring the e.m.f.'s of thermo-couples, for which it was claimed that there was very little to get out of order; the readings could be taken in broad daylight, no mirror and lamp being used; it was easily adjusted and read, and had five ranges, changed with a lever switch; it was accurate and readily calibrated. The apparatus could be used either on the "null method" or by a deflection method, the latter being more expeditious, and was self-checking.

An optical pyrometer was shown for temperatures above 600 deg. C. In this instrument the heated object is observed through a telescope, and its brightness is compared with that of a standardised electric lamp filament fitted inside the telescope. The temperature of the filament is varied by adjusting the current which passes through it, until the filament disappears, when the temperature can be read off on a calibrated scale. The instrument is portable and easy to use, and measurements can be made at a distance from the object; colour blindness does not affect the accuracy of the readings, and no part of the instrument is exposed to high temperatures or corrosive gases.

Marconi's Wireless Telegraph Co., Ltd.

The apparatus shown at this stand largely related to wireless telephony, the most novel feature being a "wireless bell" transmitter and receiver for calling attention, based on a new system. The "Subscriber's" set was another entirely new item, enabling private users to carry on duplex wireless telephony, transmitting and receiving as in wired telephony without any change-over switching. The transmitter was rated at 50 watts, with a range of 35 miles (with masts 30 ft. high). We understand that this is the first real duplex set made on a small scale. The latest "Marconiphones" for the reception of broadcast programmes were exhibited.

Record Electrical Co., Ltd.

A complete range of instruments of the well-known "Circscale" pattern was shown, for switchboard and portable use, the moving-coil deflecting over an arc of 300 deg. Included amongst these was a laboratory millivoltmeter 16 in. in diameter, with a scale 3 ft. long, and ranges of 100 and 150 mV. A new series of miniature precision "Circscale" instruments, 3 in. in diameter overall, and having scales 5¼ in. long, was worthy of note; one was a pocket ammeter with five ranges, all the shunts being self-contained, and the total weight 1¼ lb. A miniature testing set of this type had ranges of 5 and 50 A and 5, 50, and 250 V. A new moving-iron instrument for alternating current had a scale deflection of 270 deg.; this remarkable range was obtained by a new patented device of great ingenuity, there being two coaxial spindles with two moving-iron parts, the reaction between the latter being utilised to double the range of deflection. The "Record" ohmmeter and generator was shown, and we understand that a new "1923" pattern light-weight ohmmeter is in course of preparation, of remarkably small dimensions and weighing only 6 lb.

Messrs. Herbert Kennedy & Co., Ltd.

This firm showed the Elverson oscilloscope, an ingenious device which, with the aid of a special lamp flashing in synchronism with the movements of a machine under examination, enables the machine to be seen as though it were stationary, or if preferred, moving very slowly, whilst it is actually running at full speed. This instrument was described in our issue of July 28th, 1922.

The Mullard Radio Valve Co., Ltd.

This company showed a variety of valves and accessories, including silica valves for one and four kilowatts, and an experimental 10-kW valve. Smaller transmitting valves were also shown, and a new low-temperature receiving valve, taking 0.18 A at 1.4 – 1.8 V.

Messrs. Watson & Sons (Electro-medical), Ltd.

Messrs. Watson & Sons, *inter alia*, exhibited a portable Coolidge tube with lead-glass protection embodied in the bulb, and a 200,000-V tube of the latest type for deep therapy. A device was also shown for measuring the relative hardness of a tube with a selenium cell, battery and galvanometer. Other apparatus included a transformer equipment for use with current from the mains, and a sphere-gap voltmeter reading up to 250 kV, for deep therapy treatment.

Messrs. John J. Griffin & Sons, Ltd.

This exhibit consisted mainly of physical apparatus, a Tucker battery of the hygroscopic type being the chief electrical feature. In this new pattern there is no paraffin block, each battery of 20 cells being wedged into a porcelain block and supported in such a way that it can be readily replaced, literally *en bloc*. A battery of 260 cells gives about 300 volts; the elements are of carbon and zinc, with an electrolyte of $CaCl_2$. Taps are provided every 20 cells. The battery is usable for at least 18 months without attention.

A new bomb calorimeter of an inexpensive type for power-station use was also shown.

Other Exhibitors.

Messrs. W. Ottway & Co., Ltd., showed a horizontal arc for photo-printing; Messrs. Ogilvy & Co., their new electric microscope lamp; Messrs. Newton & Co., optical projection apparatus; Messrs. Negretti & Zambra, electrical resistance thermometers; Messrs. Liquid Air, Ltd., thermo-electric pyrometers; Mr. F. E. Lamplough, a "Daylamp" for colour matching, a "precision dayscreen" light filter, and a titration lamp, and Messrs. George Kent., Ltd., a new steam flow indicator.

SECRECY IN SOUTH AFRICAN CONTRACTS.

The following comments are reprinted from the *British and South African Export Gazette*:—

"There must always exist some amount of friction between the commercial world and official departments in regard to methods of dealing with contracts. That is in the nature of things, for the interests concerned are distinctly opposed in certain respects. For example, an official department with valuable contracts to place, must naturally find life pleasanter if absolute secrecy can be maintained. It knows, or believes it knows, the leading available tenderers, and finds only labour and expense in dealing with tenders and correspondence from firms outside the approved circle. On the other hand, the average business man insists that when public money is being expended on public services, the contracts involved should, as a matter of principle, be open to the widest possible competition. A good case can be made out for both points of view, and the consequence is the perennial occurence of the friction to which we have referred. But when it comes to maintaining the same reticence after the contracts have been placed the official view is less easy to understand.

"The matter has been brought into a sort of suppressed prominence of late in connection with the important railway electrification contracts placed with British firms by the Stores Department of the Union High Commissioner's Office shortly before Christmas. Apart from the briefest possible statement of the names of the successful tenderers, the public is still in blank ignorance concerning the details of those contracts, the aggregate value of which is in the neighbourhood of £2,000,000. This silence is obviously not the fault of the contractors, who are losing an amount of publicity worth thousand of pounds. Indeed, without mentioning names, for reasons which will be clear, we are in a position to state that some at least are distinctly aggrieved, but they are bound by

a clause in their contracts which prohibits them from publishing, or disclosing to newspapers or others, any particulars without the consent in writing of the Union High Commissioner."

"That, on the face of it, may not appear very oppressive, in view of the fact that the High Commissioner, an experienced newspaper man himself, is not likely to adopt an unreasonable attitude when asked for his consent. Nevertheless, the clause seems to work very unfortunately in actual practice. The effect of its insertion at all, is to make some contractors fear that they will make themselves unpopular in official quarters if they ask permission to benefit by the publicity which would be of such value to them. Therefore they hesitate to move in the matter, forgoing advertisement individually, and at the same time losing for British industry as a whole, the advantages which would accrue from wide insistence on British engineering achievements and success in competition with foreign rivals. It may seem a weak attitude for them to adopt, but no practical business man will criticise them for hesitating to endanger their prospects of future contracts, even though their fear of doing so may not wholly be justified. Something, also, is lost to South Africa itself, for its enterprise in advancing public works is hidden, and less interest in the country is stimulated among the investing, trading, and prospective emigrant sections of the Home public. Even those contractors who make the effort to secure permission to publish details, and who eventually succeed in obtaining it, are apt to find that delay, however brief, has allowed the opportunity for publicity to pass in part, if not wholly.

"In stating so much, it is only fair, of course, to recognise that the official policy is a considered one, and that it is based on what are regarded by those in authority as good and sufficient reasons. Moreover, these reasons are consistent in governing the policy at every stage, from the placing of approved firms' names on the "list" of those from whom tenders may be invited, to the final allotting and supervising of contracts. Briefly put, the object is to ensure the most complete efficiency and economy in operating the Stores Department. The mere hint that a contract is likely to be on offer brings a shoal of eager inquirers who, often with the most meagre qualifications, seek information with which to arm themselves in an attempt to secure agencies and sub-agencies. These people generally behave as though they are under the impression that a large and idle staff is waiting at the offices in Trafalgar Square to serve their private interests. They make life a burden to the frequently hard-pressed staff, and, if encouraged, would soon necessitate an increase of the staff, in spite of the urgent need for retrenchment. The same unnecessary piling up of work and expenditure on wages would occur if all contracts were open to indiscriminate tendering instead of being confined to firms on the official "list"—which "list," by the way, is a sufficiently comprehensive one, and admission to it is possible to any firm of first-class standing.

"We have reason to know that the High Commissioner and his staff are actuated by as sincere a desire to safeguard successful tenderers as to protect themselves from useless and undesirable inquiries. Their principal reason for controlling the publication of information, even after contracts have been placed—though it may seem a rather gratuitous kindness—is to hinder would-be sub-contractors and agency-snatchers from pestering the main contractors. So far the official attitude must be respected, if not fully approved. As a means of effecting economy, both as regards labour and expense, it is undoubtedly justified; but having admitted so much, we still think that it may be, and is being, carried beyond necessary lengths. If a successful contractor is willing to risk the minor ills attaching to publicity in order to secure the major advantages, we cannot see that any public or private good is served by arbitrarily hindering him. He is not even grateful for the kindly meant, but mistaken, effort to protect him against himself. All interference should cease at the point where official interests are no longer affected, and we therefore suggest for the serious consideration of the Union High Commissioner that the restraining clause in official contracts should be eliminated. Such action would be appreciated by all up-to-date contractors, by the commercial world generally, by the Press, and by that large section of the public interested in the activities of the Dominions."

SILVANUS THOMPSON MEMORIAL LECTURE.

The first Silvanus Thompson Memorial Lecture, established by former students of the Finsbury Technical College, E.C., was delivered at the College, on February 1st, by Sir Oliver Lodge, F.R.S., who took as his subject "The Basis of Wireless Communication."

Sir Charles Parsons, K.C.B., who took the chair, introduced Sir Oliver Lodge as one of the fathers of the art of wireless communication, and spoke of his early work which had borne such remarkable fruit.

Sir Oliver Lodge said that the Finsbury College had performed such invaluable work that he hoped that no more would be heard of closing it. Among the many brilliant men who had been associated with the institution, he made special mention of Ayrton and Perry, and above all, a former principal, Silvanus Thompson. The breadth of Thompson's outlook and the width of his interests were almost proverbial—he was an artist, a *littérateur*, a historian, and a linguist. He might have been alive to-day but for the strain of the war, which to such a cosmopolitan, gave great grief.

Proceeding to the subject of the lecture, and confining himself to matters prior to 1896, Sir Oliver recalled that the term "inductance" did not at first exist; Lord Kelvin introduced it as a mathematical coefficient, Maxwell spoke of self-induction, and Heaviside originated the term now used. In the early work on the production and detection of electric waves in the ether, Kelvin, Maxwell, FitzGerald, and Hertz laid the foundations which made the present superstructure possible. In 1875, Edison observed the possibility of drawing sparks from insulated objects in the neighbourhood of an electrical discharge; already in 1842, Henry, in Washington, had surmised—through a similar observation—that there was some similarity between the etherial disturbance caused by the discharge of a conductor and the light emitted from an ordinary high-temperature source. Early in the 'eighties, David Hughes, working with the microphone and galvanometer, got something like a coherer, but was discouraged from pursuing the matter. In 1865, Maxwell gave the theory of electric waves before their generation or detection was understood. He showed that they would travel with the velocity of light, that light was an electromagnetic phenomenon, that conductors of electricity must be opaque to light, and that the refractive index of a substance was intimately related to its dielectric coefficient.

This discovery aroused great enthusiasm, and one result was to influence the lecturer to devote his life to the study of electric waves. He discussed them with Fleming and FitzGerald, and spoke about them at the British Association in 1879 and later. In 1883 FitzGerald proposed the generation of the waves by using the oscillatory discharge of a Leyden jar, and the lecturer, in 1887, produced and detected them. The waves were received on wires adjusted to the right length for resonance. The experiments of Hertz, who received the waves on a nearly closed ring of wire having a short spark gap, were reported by FitzGerald at the B.A. meeting of 1888, and Sir Oliver calculated the horse-power of the oscillator—about 100 h.p. for a millionth of a second. He exhibited many of the effects of the waves at the Royal Institution in 1889, but nothing akin to signalling; that was foreshadowed, in 1892, together with the possibility of tuning, by Sir William Crookes, who spoke of wave-lengths with which to signal to specific people, and alluded to Hughes's signals made from room to room without intervening wire. In 1890 Sir Oliver employed a form of cohering contact to complete a bell circuit, and in 1893 heard of Branly's filings-coherer. In memory of Hertz, for whom Sir Oliver expressed the greatest admiration, on account of both his experimental skill and his mathematical thoroughness, he gave a lecture at the Royal Institution on "The Work of Hertz." At this lecture actual signalling with a coherer was demonstrated. This led to the grant of Lodge's patent in the United States, which was the fundamental patent of the American Marconi Co. The lecture stimulated Dr. Muirhead, Captain (now Admiral Sir Henry) Jackson, Admiral Popoff, Professor Righi and others to their experimental successes. In 1896 Mr. Marconi came to this country—and the rest in common knowledge.

"Incidentally, however," said the lecturer, "I want to say two things to those who are occupied with the subject to-day. First, do not hesitate to speak and think of the ether of space, as the continuous reality which connects us all up, and which welds, not only us, but all the planets into a continuous system. Do not be misled by any misapprehensions of the theory of relativity into supposing that that theory dispenses with the ether. For anything like a physical explanation of light or electricity or magnetism or cohesion or gravitation, the ether is indispensable. . . . Secondly, we must congratulate all those whose wonderful and rapid advances have rendered possible the astonishing feat of, in any sense and by whatever means, carrying the human voice across the Atlantic . . . . . made possible by the valves of Professor Fleming, Dr. Lee de Forest and others. . . . ."

Referring to an unpublished pamphlet by Silvanus Thompson, on "The Early History of Radiosignalling," from which he had largely quoted, Sir Oliver Lodge expressed his gratitude to one so well qualified to deal with the subject, and said: "He was a good friend, and posterity may be glad to have this record of what he had to say concerning the origin and basis of wireless communication."

After heartily thanking the lecturer, and the chairman for presiding, the audience were entertained at a conversazoine in the laboratories. The present Principal (Dr. Eccles) as well as past students—notably, Mr. W. M. Mordey (past-president of the Institution of Electrical Engineers), Professor Coker, and Professor Desch—gave demonstrations of their latest scientific work. A beautiful collection of Dr. Thompson's paintings was on view, as well as Gilbert's "De Magnete," 1601, which was translated by him. Coils constructed by Faraday, the first Nicol Prism, accoustical and optical models, and other valuable personal relics were lent by the late doctor's family.

THE MAINTENANCE OF VOLTAGE ON A D.C. DISTRIBUTION SYSTEM.

A Fully Automatic Sub-Station.

By P. J. ROBINSON, A.M.I.E.E.

(*Abstract of paper read before the* Institution of Electrical Engineers.)

The gradual growth and expansion of our cities owing to increased industrial activities and better transport facilities have brought large areas that were thinly populated suburbs into close touch with the city, and caused them to be more densely populated. This has meant that the original electricity supply systems laid down, in some cases many years ago, have gradually extended until such time as the length of feeders has become troublesome owing to the voltage drop. The more extensive use of domestic apparatus has had the effect of raising the average load taken by consumers from ½ to 1 kW for lighting up to 5 or 6 kW on the average when domestic apparatus such as cookers, radiators, vacuum cleaners, irons, &c., has been installed. This has necessitated more feeding points along the system to make full use of the copper laid down.

This problem of maintaining a more constant voltage over the whole network, and at the same time keeping down operating costs and capital costs, has been exercising the minds of many electric supply engineers in this country, and Liverpool is in much the same position as other authorities. Recognising that the matter had to be dealt with, and appreciating the alternatives, *i.e.*, to lay new feeders, or to change over sections of the distribution to a.c. supply, building up either a new distribution system or using old d.c. mains for a.c. supply (the latter being almost prohibitive, due to the cost of changing consumers' apparatus, motors, battery-charging sets, and many other pieces of apparatus not fitted with universal motors), it was finally decided to try to deal with the matter by installing fully automatically operated stations at different points of the system, thereby reducing operating costs to a minimum, and at the same time enabling the existing mains to be utilised to the best advantage.

Acting on this decision a general scheme was evolved for the control of a three-wire system with the conditions that would have to be met in Liverpool. The scheme and conditions were as follows: (1) the station was to have a capacity of 500 kW, with room for extension; (2) the station should cut in after the voltage on the low-pressure feeder bars had fallen and remained low for a predetermined time. (This time-lag was to avoid the station's cutting-in with temporary falls in voltage); (3) the station should cut out after the current on the busbars had fallen and remained low at some fixed figure for a predetermined time; (4) the station was to operate plant running across a three-wire system, 230 volts between each outer and the neutral, and to maintain a balance in pressure; (5) the station should operate in parallel with other stations, and other plant in the same station at a later date; (6) if the load demanded, due to existing manually-operated stations shutting down, was greater than its capacity it should not cut in, and, if already running, the output should be limited to the capacity of the plant; (7) in the event of a fault on either the negative or positive side of the system, the automatic switch controlling that particular circuit should operate to cut it out, without interference with any other circuit; (8) in the event of a short-circuit on the outers of a feeder that feeder should be cut out without interference with any other circuit or the running of the plant generally; (9) the middle wire of the system being earthed through a limiting resistance at the manually-operated stations, it was decided to deal with an earth fault from those stations.

To meet the above conditions it was decided to proceed with a station equipped as follows:—

One tap-started 500-kW rotary converter (with brush-lifting gear) coupled through its transformer to the 6,000-volt, three-phase, 50-period supply on the one side, and on the other to a three-wire system with 460 volts across the outers and 230 volts to the middle wire, the latter being connected to a tapping on one leg of the transformer supplying the rotary converter; one high-pressure cubicle of moulded stone equipped with an electrically-operated oil switch with a.c. closing coil, to control the rotary converter; two liquid fuses to control the operating transformer (15 kVA) which supplies the operating coils on most of the relays and is therefore permanently connected to the line; one three-phase potential transformer for various instruments; necessary isolating switches; low-pressure d.c. panel for rotary converter, equipped with knife switches and electrically-operated contactors in the main circuit, with ammeters on each pole, a voltmeter, and field regulator; low-pressure feeder panels for control of four three-wire feeders, equipped with electrically-operated contactors in the main circuit and knife switches in the operating circuit to control the main contactors in the event of a feeder requiring to be "laid off"; and other panels to have mounted thereon numerous relays, devices and contactors.

The paper contains a diagram in which the connections are arranged schematically.* The machine is started by means of low-voltage relays; if the network voltage falls below a predetermined figure a connection is made through a time-limiting device, which delays the action of the master relay for a certain period. This is necessary to prevent temporary drops in pressure starting the gear. The master relay then puts into operation relays controlling the following sequence: (*a*) lifts the brushes off the commutator; (*b*) closes h.p. switch which puts pressure on to the rotary transformer; (*c*) closes l.p., a.c., contactors on half voltage of transformer; (*d*) rotary runs up to speed; (*e*) polarity of d.c. is checked; if correct, sequence carries on; if not, polarity is corrected by field-reversing relay; (*f*) closes l.p., a.c., contactors on to full pressure of transformers; (*g*) lowers the brushes on to commutator; (*h*) d.c. contactors make circuit to d.c. bus-bars through resistances which limit the current that can pass; if this current is not excessive, contactors cut out limiting resistances and put rotary directly on to the bars; (*k*) d.c. contactors on feeders close.

Should the various relays installed for taking care of overloads on the d.c. feeders, excessive loads on the rotary, &c., or thermostats in the bearings operate, the plant is shut down and all the automatic gear locked out, so that an inspector must ascertain the trouble and reset the relay before the plant can again operate.

The sequence of operations described above is very quickly performed, the total time from the demand arising to the connection of the rotary converter to the line being seldom greater than 55 seconds, plus the time-lag on the relay. This is a great advance over manual operation, which necessitates synchronising by hand.

The operation of the station has surpassed expectation in that its behaviour has been almost perfect since it was first put on load, or rather, put itself on load.

The outgoing d.c. feeders are protected with automatic reclosing contactors having overload and inverse time-limit relays.

All relays are of substantial construction, and it is not anticipated that they will give any trouble provided that they have reasonable attention.

A second station, on similar lines to the one described, is in hand. It is of interest to refer to the problem which had to be dealt with and the cost comparison which influenced the decision.

The network between the two stations mentioned was laid at a pre-war cost of approximately £20,858, but as only 40 per cent. was available for useful work, due to voltage-drop, a feed into the centre would enhance its value nearly three times. The following five methods were open:—

(1) To change over the whole of the distribution in the area in question to alternating current, by connecting the d.c. mains across a split single-phase transformer.

(2) To replace the whole of the d.c. mains by a.c. mains, creating a new a.c. system and finally scrapping the d.c. mains; or else to superimpose on the area an a.c. supply.

The cost and disadvantages of the above methods led to their elimination, and only the three following schemes were considered in detail:—

(3) To lay new d.c. feeders from the existing stations to a central point of the system, the feeders to be of sufficient capacity to increase considerably the value of the system.

(4) To erect a new building and equip it with manually-operated plant with three double-shifts of operators.

(5) To erect a new building and equip it with fully-automatic plant requiring the occasional services of an inspector.

Whichever of the three schemes was decided upon, new buildings and plant would be required, therefore, in considering the comparative cost of the schemes, the cost of buildings, rotary converter, manually-operated converter and feeder gear has been taken as being common to all.

Considering first the capital cost of alternatives (3), (4) and (5) and ignoring the items common to each, the following would appear to be a fair basis of comparison:—

(3) The cost of the new cables would be £12,500. The scheme would require very little more attention than at present. The cable losses were neglected; plant losses in converters, being common to all three schemes, were also neglected, so that the only charges on this scheme are the capital charges.

* The sub-station was described in the Electrical Review of December 15th; an illustration appeared, and the actions of the relays were detailed.

(4) Would require three shifts of two men per shift, at £1,285 per annum. The lighting of the station would cost about £20 per annum, so that the total running charges would be £1,305 per annum.

In (5) the cost of the automatic gear, over and above the cost of the manually-operated gear, would be £1,795. The scheme would require more skilled inspection and a consequently higher rate of pay than the manually-operated station, but this would be more than balanced by the reduction in clerical work at headquarters. The station lighting would be nil.

The maintenance in the case of all three alternatives has been considered as common to each, although the maintenance on scheme (5) might be slightly in excess of that on either scheme (3) or (4).

As pointed out above, three shifts would be required in the manually-operated station (4), although possibly only working 50 per cent. of its time, and on this basis station (5), operating on load for 12 hours and being idle for 12 hours per day, with units at 1d. for operation purposes, would cost £93 per annum for energy.— This gives the following actual annual charges:—

(3) £12,500 at, say, 9 per cent.		£1,125
(4) Running charges		£1,305
(5) £1,795 at, say, 9 per cent = £162 Running charge ... ... = £93	}	£255

It would appear from the above figures that, taking the difference between (3) and (5), there would be a saving of £870 in favour of (5) and a difference between (4) and (5) of £1,050 per annum in favour of (5), which represents a considerable saving in the cost of units supplied from this station.

The energy required to operate the station is as follows:—

When idle the operating transformer and also the d.c. low-pressure feeder contactors, of which there are eight (the neutral switches not being automatic), are alive, and 1,719 watts is required. When operating the operating contactors, in addition to the above, are all closed, making a total of 3,397 watts, and it was on the above figures that the operating cost of £93 was calculated.

In practice it is found that, although the voltage regulator keeps the pressure steady, it does not allow for a rise in pressure with increase in load, *i.e.*, there is no compounding effect. This point in a manually-operated station is taken care of by the operator, so that a contactor type of field regulator is being introduced, which is operated from the main ammeter shunts, and which will automatically raise or lower the pressure 1 volt for every 100 amperes increase or decrease in load.

Numerous tests have been applied to prove the ability of the automatic gear to operate under faulty conditions, and its operation has been not only satisfactory, but much more accurate and rapid than manual operation, the various relays being able to discriminate more rapidly than the human mind.

The author thanks Mr. H. Dickinson (the City Electrical Engineer of Liverpool) for permission to publish the information contained in the paper, and to Mr. L. Breach for his valuable assistance in the preparation thereof.

An appendix to the paper details the construction and operation of the relays.

Discussion.

Mr. B. Welbourn said that cable makers had nothing to fear because the adoption of the automatic sub-station would involve the laying of more cables. He had seen the Liverpool sub-station on three occasions, and on two of them the rotaries started up on the wrong polarity, but the switches changed over very rapidly. Last year he saw a fully-automatic traction sub-station near Chicago, the plant being made in that case by the American General Electric Co. The plant at Liverpool, he believed, was made by the Westinghouse Co., but the Chicago plant operated in the same perfect manner as the author had described in relation to the Liverpool plant. A point which struck him was that there were too many "gadgets" upon the plant, and some of them ought to be eliminated. There seemed no need, for instance, to have thermostats on every bearing, and certain risks could be accepted as commercial risks. A good case had been made out in the paper, financially, for the decision at Liverpool, and it was merely following out the tendency to adopt more and more labour-saving devices in view of high labour cost. At the same time, even the work people need not be afraid of this tendency, because experience had shown that labour-saving devices brought more business and made more work for labour. The plant at Liverpool was of American origin, and it would be interesting to hear what steps were being taken by British manufacturers to be ready for the considerable market which was undoubtedly coming. He had heard during the last few days of an important order having been placed in this country by a large city for an automatic sub-station, and it was an open secret that the plant was to be made in this country. Finally, Mr. Welbourn mentioned that during the Institution's summer visit to Lancashire a visit was being arranged to the Liverpool sub-station.

Mr. G. H. Morris agreed that it would be an advantage if the number of "gadgets" was reduced, but at the same time he confirmed the good opinions expressed with regard to the Liverpool sub-station. Regarding the author's comparison of cost, he did not think it would be necessary to have two men per shift, nor would three shifts be necessary, with the manually-operated sub-station.

Mr. H. Brazil referred to the value of automatic sub-stations in assisting to keep up the pressure at the outlying ends of distribution networks, but asked whether it would be possible to use them in dense areas like the City of London, where there might be 500 or 600 miles of cable? What was going to happen to the automatic sub-station if a "short" occurred? It was difficult to imagine that it would keep the pressure up. For the particular conditions at Liverpool, however, it seemed all right. He did not agree with eliminating the thermostats; at any rate, not without careful thought. How would the scheme act if the rotaries would not synchronise?

Prof. E. W. Marchant said that although on paper the scheme seemed complicated, in practice the equipment did not give the appearance of being a complicated thing. Up to the present time, in distributing networks the only thing that had mattered was the pressure drop. The results of the adoption of automatic sub-stations at relatively close intervals, however, would be that the heating of the cables would become important owing to an increase in current density, and in this connection he suggested that instead of laying mains of large section there should be a larger number of smaller section mains. He believed there would be an increasing number of automatic sub-stations adopted in this country.

Mr. Badham pointed out that the use of a motor for the brush-lifting gear (as at Liverpool) tended to increase the number of "gadgets." He had tested the 1,200-volt rotaries for Australia, on which ordinary self-synchronising connections were used. There was an exciter, belt driven from the main machines and connected to an auxiliary shunt winding of the machine, so that the machine was always excited. By this means the machines always synchronised and the device also had the effect of reducing the number of coils required. A large order had just been placed for automatic gear of this type, which would be made in this country and, he believed, it would show some improvements on American designs.

Mr. W. M. Selvey said the broad point of the paper was that the more extensive use of domestic apparatus had had the effect of raising the average load taken by consumers from ½ kW to 1 kW for lighting up to 5 or 6 kW on the average when domestic apparatus was used. The author had to do something at once to deal with this and apparently he was going to perpetuate low-pressure distribution. If, in order to deal with the increase in the average load, from ½ kW to 1 kW, he had spent £20,000 to improve the utilisation factor of the cables, how much would he have to spend in order to deal with the increase to 5 or 6 kW which he said would be the case with the more increased use of domestic appliances? That might mean an expenditure of £100,000 on cables and, although he did not suggest that the author had not adopted the right solution in this case, it was a very serious thing to perpetuate l.p. distribution. Great difficulties would arise if they went on taking the cooking and the heating load on the old system, and he could not help feeling that automatic sub-stations should be confined to traction. In this matter their real enemy was amperes; it was voltage they wanted and the smallest cable that could be used. Even the cable makers would agree that anything that could be done to cheapen the cost of electricity would result in an enormous increase in its use.

Mr. Cheetham pointed out that American manufacturers had thoroughly tested their designs before they put them on the market. That was a warning British makers should take to heart and be sure their gear was thoroughly sound before it was put into operation. After all, automatic sub-stations were but the logical extension of protective and control gear, and a point to be borne in mind was that it required frequent inspection. In the past protective gear had been looked upon as only being required to come into operation at frequent intervals, and on that account it received little attention by way of inspection, and to that fact could be attributed the bad name which protective gear had with some engineers. Reference had been made to the apparent complexity of the arrangement described in the paper, but when one examined the apparatus it was relatively simple compared with a multiple-unit train-control system for instance. Moreover, one device not described by the author was a traction feeder that discriminated between a short circuit and an overload. An ordinary a.c. current transformer was put on to the d.c. mains, and the rate of change of current was measured instead of the actual value of the current, a very simple device which enabled the feeder to be disconnected immediately a short circuit occurred, but allowed it to remain on load to its full capacity in the case of an ordinary overload. Automatic sub-stations enabled a considerable reduction in cost to be made as compared with manually-operated sub-stations, and in traction work the advantage was a reduction of the light-load running costs in the case of an infrequent service, the load efficiency of the station being improved because it was not called upon to operate until there was definitely some load for it. There was a promising future for automatic sub-stations in connection with hydro-electric schemes.

Mr. A. H. Baldwin, speaking on the question of complexity, referred to the great reliability of automatic telephone systems, and pointed out that there were 64 delays in the system described in the paper, whereas the number of relays brought

into operation at every call on an automatic telephone system was in excess of that figure.

MR. ROSS also reassured those who were sceptical with regard to the complication of automatic sub-stations, and added that the devices were a good insurance and well worth the little extra money involved. Mention had been made of motor-started as against tap-started rotaries. In America this question had developed mainly along the line of tap-started rotaries, and it seemed to him a pity to have to put a pony motor on the end of the rotary, which was only used for starting on odd occasions. The bogey of tap starting in the past had been the effect on the mains. Many supply engineers who had no fear in putting a 500-h.p. induction motor on to the mains seemed to think that a tap-started rotary was going to shut the system down every time it started. He believed the average tap-started rotor did not take more than 75 per cent. of its kVA rating and its kick was not felt on the mains. Again, there really need be no qualms about brush lifting, because experience had shown that tap-started rotaries did not cause trouble through the brush not finding its proper circle.

MR. ROBINSON, who proposed to reply to the discussion in detail when he had completed reading the paper at the various Centres, said he slept a lot better at night knowing that thermostats were used than he would if they were not there. The sub-station had been given harder work during the past six months than it would get normally in five years, and it had worked so satisfactorily that a new building was being erected to take another set. The figures of the cost of running the manually-operated sub-station were actual ones, although he agreed that it might be possible to do without two men on a shift and to run two shifts. In Liverpool, however, he had been employing a second man and working three shifts.

REVIEWS.

Crystal Receivers for Broadcast Reception: By PERCY W. HARRIS. Pp. 74; figs. 75. London: The Wireless Press, Ltd. Price 1s. 6d. net.

The author explains simply the principles of reception with crystal receivers, how they can best be adjusted, and how a complete set can be constructed suitable for the reception of broadcast concerts and time signals from the Eiffel Tower station. The book contains 75 illustrations, and should be useful to the beginner who wishes to purchase or construct a crystal set and get the best results out of it.

Direction and Position Finding by Wireless. By R. KEEN, B. Eng. (Hons.), Sheffield, A.M.I.E.E. Pp. 376; figs. 254. London: The Wireless Press, Ltd. Price 9s. net.

This book fills a gap in wireless literature, and fills it well. It is, indeed, the first book on direction finding that can be classed as a standard work. Mr. Keen is an author in the true sense of the word, an authority, and he has spared no pains to make his book up to date and as complete as the present state of knowledge permits. He deals fully with the principles of the subject, its practical operation, and the construction of apparatus, in a manner which should make it of the greatest interest, not only to the engineer and the operator, but to the student of wireless telegraphy in general.

There is a chapter on the use and maintenance of valve circuits, but for further information on valves the reader is referred to the numerous text books on that subject. Directional wireless, in all its applications, including ship and aircraft work, is dealt with, and there are chapters on freak phenomena and fault clearing which are most valuable, as they are the outcome of an accumulation of data arrived at through much experimental and research work, especially on the part of the Marconi Co. and the Air Force.

There are also interesting chapters on maps and astronomy.

An excellent bibliography, which should be most valuable to the student, is included, as well as an index, and the book is illustrated with over 250 well-produced photographs and diagrams.

This book will be welcomed by all who are seriously interested in the developments of wireless signalling.

Wireless Telephony For All. By LAURENCE M. COCKADAY. Pp. 12+211; figs. 65. London: Herbert Jenkins, Ltd. Price 5s. net.

The Foreword tells us that "there has been an increasing need of literature on the subject written in 'everyman's language,' with the sole idea of dispelling the shroud of mystery surrounding wireless in the layman's mind," and Mr. Cockaday sets out to write "so that the boy of sixteen and the man of sixty will read it with equal interest and satisfaction." Being neither sixteen nor sixty, we confess that we were somewhat out of breath after being conducted through the whole theory of wireless telephony in 120 pages (including 49 diagrams) in large type of everyman's language. There is a certain directness in this language, such as "the voice is changed into an electric current," and, "then come back to his point and we will 'dig in' to this stuff together." It does, indeed, require some "digging in," but the amateur reader here, as across the Atlantic, will find stuff that is worth digging for if he takes it easy. Pages 121 to 190 are taken up with instructions for building up and maintaining a complete wireless telephone transmitter and receiver. The remaining pages give lists of waves, call signals, international abbreviations, and technical terms. The book contains 65 clear diagrams.

Patents for Inventions. By J. EWART WALKER, B.A., and R. BRUCE FOSTER, B.Sc. Pp. 377. London: Sir Isaac Pitman and Sons, Ltd. Price 21s. net.

The authors, who are barristers-at-law, have set out to write a legal book which shall be intelligible to the layman. They appear to have succeeded, but the volume is naturally not free from the copious references to other works and case-law which abound in all writings on legal subjects. These authorities have been numbered and indexed, and they are referred to by their numbers in the text; there are over 500 of them.

An endeavour has been made to follow a logical sequence, beginning with the nature of patents and tracing the procedure which an inventor must follow in securing a patent. In the introductory chapter a number of points in connection with patents and inventors, as rights and obligations, the International Convention, administration of the Patent Acts, offences, agency, duration of patents, and other relevant matters.

Procedure towards the obtaining of a patent is covered by the next chapter. It is pointed out that the choice of title is not unimportant, as in construing the specification the scope of an invention is, to some extent, limited by the title. The advantages of provisional protection are set out and the importance of clearly stating the boundaries of the claim is noted; the neglect of the latter is a fruitful source of litigation. The methods adopted by the Patent Office are admirably stated, and the reader is made aware of the numerous transgressions he is liable to make—even innocently. Special cases—secret patents, cognate inventions, patents of addition, &c.—are given separate treatment. The third chapter deals with opposition to the grant of a patent. This is classified by the authors under six heads, each of which is considered in detail, and includes fraudulent conversion, claims of assistants, prior publication, &c. The method of opposing the grant of a patent is detailed. An important chapter is that on the construction and interpretation of complete specifications, and it is of interest to remember that the actual "language" construction of such documents is not the deciding factor, but the meaning conveyed to one who is capable of understanding the invention. In all cases mentioned in the work chemical inventions receive the separate attention which is necessitated by their peculiar features. Here again many warnings are sounded in connection with the use of terms; it is often forgotten that an ordinary technical description is insufficient by itself, phraseology is as important in specifications as in all other legal documents. The ground covered in Chapter V, which deals with the validity of patents, is, in part, the same that the chapter on the opposing of patents covers. Conditions which render a patent invalid are concisely mentioned, and include lack of utility, novelty, or ingenuity, disconformity between provisional and complete specifications, and insufficient or improper description. What "prior publication" means is fully treated, and references to judgments in this regard are numerous; some of the distinctions between publication and non-publication are very fine. It is noted that commercial success is not a test of "utility," but "ingenuity" is liberally interpreted and actual examples are quoted.

Much space is devoted to a review of the rights of a patentee, and the items embodied in this section treat of such matters as infringement actions, the recovery of royalties, transfer of rights, amendments and extensions, war legislation, rights of patentees in relation to the Crown, &c. In addition to aiding the inventor to protect his rights, possible answers to a lawsuit are also indicated, enabling the inventor to forsesee a defendant's case. A question of interest touched upon in this chapter is the rights of co-patentees "*inter se*." Following the inventor's rights his liabilities are dealt with. These are put under four headings: revocation of patents; compulsory licences; actions to restrain threats; and patents restored under the Treaties of Peace, and each division receives very full treatment.

The appendices are ten in number, and between them occupy more than half of the volume. As the bulk of these are reproduced Acts and Orders, which can be procured from official sources, they may be considered by many to add unnecessarily to the size of the work. On the other hand, there is some advantage in having these put conveniently together. A considerable amount of work was carried out by the authors in annotating and paralleling the Patents and Designs Acts, 1907-1919, consisting of the Act of 1907, with amendments effected by the subsequent Acts of 1914 and 1919. Appendix IV contains reproductions of all the forms which an inventor must complete, together with those for use in special circumstances. The work is concluded by a fifteen-page index, which appears to serve its purpose satisfactorily.

NEW PATENTS APPLIED FOR, 1923.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. SEYTON-JONES, O'DELL AND STEPHENS, Patent Agents, 285, High Holborn, London, W.C. 1.

1,884. "Electrically-driven submersible pump equipments." A. D. Constable and F. P. Fletcher. January 22nd.
1,901. "Electric transmitter microphones." E. D. Young. January 22nd.
1,915. "Mast for wireless telegraphy, &c." E. H. Aldam. January 22nd.
1,916. "Electro-magnetic phonograph transmitters." S. March and H. Nunns. January 22nd.
1,930. "Electrical apparatus for high-frequency circuits." A. H. S. MacCallum. January 22nd.
1,934. "Sound-reproducing devices." A. Alexander (Herald Laboratories, Inc.). January 22nd.
1,940. "Electric switches." British Thomson-Houston Co., Ltd. (General Electric Co.). January 22nd.
1,943. "Electric amplifying apparatus." Westinghouse Electric and Manufacturing Co. January 22nd. (United States, January 20th, 1922.)
1,955. "Electron discharge devices." Western Electric Co., Ltd. (Western Electric Co., Inc.). January 22nd.
1,959. "Panels or connection boards for wireless apparatus." J. G. Maitland-Edwards and J. W. Hall. January 22nd.
1,962. "Sparking plugs." H. D. H. Drane, F. Reynolds, and Thermal Syndicate, Ltd. January 22nd.
1,964. "Vacuum tubes or valves." A. Blake and J. P. Prangnel. January 22nd.
1,965. "Electric heater resistance elements." R. W. Reynolds. January 22nd.
1,975. "Apparatus for electrolytic deposition of metals." A. H. W. Cleave. January 22nd.
1,986. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd. January 22nd. (United States, May 25th, 1922.)
1,996. "Wireless telegraphy, &c." R. W. Brown and F. C. Poulton. January 23rd.
2,016. "Aerial insulator." L. Howell. January 23rd.
2,028. "Electrolytic rectifier." A. Bolton. January 23rd.
2,039. "Electric railway signal." A. P. Withers. January 23rd.
2,046. "Means for coupling electric starting motors with explosion engines." G. Harrison (Luma-Werke Akt. Ges.). January 23rd.
2,047. "Thermionic valves." L. Bronkhorst and C. S. Elliott. January 23rd.
2,048. "High-frequency intervalve transformers and condensers." W. J. Rickets. January 23rd.
2,049. "Loud-speaking telephones." W. J. Rickets. January 23rd.
2,050. "Loud-speaking telephones." W. J. Rickets. January 23rd.
2,055. "Wireless receiving apparatus." J. W. Barber. January 23rd.
2,057. "Electric switches." British Thomson-Houston Co., Ltd., and H. Trencham. January 23rd.
2,058. "Wireless receiving apparatus." British Thomson-Houston Co., Ltd., J. H. Butcher and A. P. Young. January 23rd.
2,065. "Telephone systems." Western Electric Co., Ltd. (Western Electric Co., Inc.). January 23rd.
2,066. "Electric flat irons." W. T. Hoofnagle. January 23rd.
2,075. "Electric annealing, &c., furnaces." O. Coradi. January 23rd. (Switzerland, January 24th, 1922.)
2,079. "Signalling devices for tramways, &c." L. H. Smith. January 23rd.
2,081. "Radio-telegraphy, &c." J. W. Miller. January 23rd.
2,083. "Electric cooking stoves." E. C. R. Marks (J. Roberts). January 23rd.
2,086. "Train-control apparatus." E. C. R. Marks (Clifford International Corporation)). January 23rd.
2,087. "Manufacture of electric wires." Boston Insulated Wire and Cable Co. January 23rd. (United States, February 6th, 1922.)
2,089. "Systems for operating electric reciprocating motors." Central Electric Tool Co. January 23rd. (United States, March 6th, 1922.)
2,092. "Electric table, wall, &c., lamps." C. & W. Bohnert. January 23rd. (Germany, January 26th, 1922.)
2,093. "Mine signalling systems, &c." Automatic Telephone Manufacturing Co., Ltd., and C. Remington. January 23rd.
2,115. "Electro-mechanical toys, &c." C. Kratt. January 24th.
2,130. "Electric warning horns." F. E. Brown and Harris & Sheldon, Ltd. January 24th.
2,132. "Earthing and short-circuiting device for switchgear." C. J. Hunter and T. N. Tate. January 24th.
2,141. "Variable electrostatic condensers." C. P. Miller, J. A. Platts, and H. H. Shilton. January 24th.
2,156. "Electric arc welding." W. Langdon-Davies and A. Soames. January 24th.
2,158. "Devices for charging accumulator cells." A. R. Angus. January 24th.
2,162. "Means for limiting pressure from explosion inside cases for electric switchgear, &c." W. de Renzi. January 24th.
2,163. "Thermionic valves, &c." Mullard Radio Valve Co., Ltd., and T. W. Price. January 24th.
2,175. "Suspenders for electric hair-waving machines." I. Calvete. January 24th.
2,184. "Electrostatic transformers, &c." E. E. Tasker. January 24th.
2,185. "Phase and frequency converter." Allmänna Svenska Elektriska Aktiebolaget and B. Nordfeldt. January 24th.
2,193. "Electric controllers." Electro-Mechanical Brake Co., Ltd., and M. J. Pattison. January 24th.
2,199. "Differential heat effects produced in conductors by induced currents of electricity." D. F. Campbell. January 24th.
2,209. "Sound amplifying device." R. H. Billingsley and P. L. Wostear. January 24th.
2,227. "Automatic train-control systems." General Railway Signal Co. January 24th. (United States, January 26th, 1922.)
2,244. "Suspension devices for electric lamps, &c." G. H. Tonks. January 25th.
2,246. "Electrically-driven pump and blower sets." B. W. Hurd. January 25th.
2,250. "Induction coils." H. Ingham. January 25th.
2,255. "Electric aids for the deaf." V. A. Foot. January 25th.
2,259. "Crystal detectors for radio apparatus." A. M. Chalmers and A. Marr. January 25th.
2,261. "Wireless receiving sets." A. Page. January 25th.
2,262. "Crystal detector." A. S. A. Clunie. January 25th.
2,291. "Gas-filled discharge tubes." Naamlooze Vennootschap Philips' Gloeilampenfabrieken. January 25th. (Holland, February 15th, 1922.)
2,295. "Transmission of sound in gramophones, wireless apparatus, &c." T. Mandelstam. January 25th.
2,306. "Wireless receiving apparatus." G. A. Morley. January 25th.
2,312. "Insulation of fluid-cooled parts of electrical devices." E. Y. Robinson. January 25th.
2,313. "Vacuum electric tubes." E. Y. Robinson. January 25th.
2,314. "Electric insulators." Metropolitan-Vickers Electrical Co., Ltd. January 25th. (United States, April 1st, 1922.)
2,322. "Electric transmission of signals." J. Bethenod. January 25th. (France, February 2nd, 1922.)
2,345. "Wireless receivers." R. K. Spencer. January 25th.
2,350. "Mechanical device for sensitive tuning of wireless telephonic, &c., instruments." E. H. Goddard. January 26th.
2,363. "Illuminated signs." G. Warnkess. January 26th.
2,396. "Electric switches." A. C. Smith. January 26th.
2,419. "Speed-controlling mechanism for paper-making, &c., machines." British Thomson-Houston Co., Ltd. (General Electric Co.). January 26th.
2,420. "Automatic reclosing circuit-breaker systems." British Thomson-Houston Co., Ltd. (General Electric Co.). January 26th.
2,426. "Method for treatment of paper for electric insulator." Sluminite Insulator Co., Ltd., and F. V. Wythes. January 26th.
2,432. "Secondary battery plates or electrodes." J. T. Prestige and W. J. Thompson. January 26th.
2,433. "Printing telegraph systems." T. Lenaghan. January 26th.
2,436. "Illuminated signs, &c." Bovis, Ltd., and S. G. Joseph. January 26th.
2,457. "Electric resistances." P. R. Coursey and Dubilier Condenser Co. (1920), Ltd. January 26th.
2,464. "Portable electric lamps." W. Strange. January 26th.
2,471. "Electric switchgear or cut-outs." K. A. B. Gilfillan. January 26th.
2,480. "Electric fuse boxes and fuses therefor." C. W. Cox. January 27th.
2,490. "Magneto, &c., couplings." J. R. Stephens. January 27th.
2,498. "Starting and speed control of electric motors." C. C. Garrard, A. H. Railing, and W. Wilson. January 27th.
2,503. "Wireless apparatus." H. A. Stevenson. January 27th.
2,531. "Illuminated signs." G. Warnkess. January 27th.
2,537. "Electron tubes." Metropolitan-Vickers Electrical Co., Ltd. January 27th. (United States, April 1st, 1922.)
2,541. "Electric heaters for cooking." H. Hunt. January 27th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1921.

23,996. "Electric fuse boards." J. B. Tucker. September 9th, 1921. (191,427.)
24,225. "Telegraphic transmission of pictures." J. C. Grant. September 12th, 1921. (Addition to 178,145.) (191,430.)
26,633. "Detection and localisation of faults in underground cables." A. M. Taylor. October 8th, 1921. (191,443.)
26,751. "Electric ignition and lighting generators, particularly adapted for automobiles." M. Feldine. October 8th, 1920. (170,608.)
26,933. "Methods of, and apparatus for working quartz." British Thomson-Houston Co., Ltd. (General Electric Co.). October 11th, 1921. (191,463.)
27,310. "Radio receiving systems." British Thomson-Houston Co., Ltd. (General Electric Co.). October 14th, 1921. (191,485.)
27,344. "Inert electric batteries." C. S. Mummery and Ever-Ready Co. (Great Britain), Ltd. October 14th, 1921. (191,488.)
27,346. "Electro-magnetic chucks." W. Zehnder. October 16th, 1920. (170,306.)
27,455. "Device for therapeutic treatment by ultra-violet rays." R. B. C. Sheridan. October 15th, 1921. (Cognate application 19,551/22.) (191,495.)
28,458. "Means for controlling the speed of machines wherein thread and the like is wound, such, for example, as ring-spinning frames." English Electric Co., Ltd., and W. E. Darlington. October 20th, 1921. (191,511.)
28,688. "Bonding-devices for electrical junction boxes." J. F. Watson and Callender's Cable and Construction Co., Ltd. October 28th, 1921. (191,513.)
28,724. "Automatic regulator for electric, steam, or hot-water radiators, the same being also applicable for gas, heating, fire-alarm devices, refrigerating control, and other temperature-control uses." R. Maclaren. November 26th, 1921. (191,515.)
28,865. "Speed-controlling mechanism for ring-spinning frames and the like." English Electric Co., Ltd., and W. E. Darlington. October 31st, 1921. (191,519.)
29,388. "Means for supporting telephone transmitters and the like." E. A. Graham. November 4th, 1921. (191,525.)
29,428. "Wireless transmitting systems." P. O. Pedersen. November 18th, 1920. (171,683.)
30,371. "Automatic switches for use in telephone or like systems." Automatic Telephone Manufacturing Co., Ltd. November 23rd, 1920.. (171,995.)
30,724. "Mechanism for selectively controlling the duration of operation of clutches." T. Lumsden and W. S. Lumsden. November 17th, 1921. (191,546.)
30,729. "Apparatus for treating oil, particularly adapted for reclaiming used lubricating oil." British Thomson-Houston Co., Ltd. (General Electric Co.). November 17th, 1921. (191,547.)
30,860. "Electric coils." W. W. Burnham. November 18th, 1921. (191,550.)
30,921. "Axle boxes for tramcars and the like." T. Blancy. November 19th, 1921. (191,552.)
31,069. "Electric excess-current cut-out." F. Miller. November 21st, 1921. (191,560.)
31,950. "Multi-wire electric safety fuse." K. V. I. Jensen and Jensen Trading Co., Ltd. November 29th, 1921. (191,566.)
32,482. "Electric fuses." L. Bertran. January 19th, 1921. (174,323.)
32,501. "Indicator systems for lifts and the like." Sterling Telephone and Electric Co., Ltd., and F. G. Bell. December 3rd, 1921. (Cognate application 10,510/22.) (191,572.)
33,466. "Electric auto-transformers." A. Della Riccia. December 13th, 1920. (172,959.)
34,408. "X-ray tubes." Westinghouse Lamp Co. December 21st, 1920. (173,238.)
34,670. "Electric switch-operating mechanism." British Thomson-Houston Co., Ltd. (General Electric Co.). December 23rd, 1921. (191,596.)

1922.

1,442. "Variable electric condensers." V. J. Hinkley. January 17th, 1922. (191,618.)
3,724. "Electric switches." H. H. Berry and Berry's Electric, Ltd. February 8th, 1922. (191,636.)
4,467. "Electric circuit controllers." British Thomson-Houston Co., Ltd. (General Electric Co.). February 15th, 1922. (191,638.)
4,637. "Construction of a single fluid primary cell." F. Weatherill. February 16th, 1922. (191,639.)
6,828. "Spot lights for automobiles." E. Johnson. March 16th, 1921.) (177,157.)
7,174. "Couplings for machines of the high-voltage direct-current series system." C. J. Belli and Soc. Anon. des Ateliers de Secheron. April 15th, 1921. (178,421.)
8,469. "Cathode-ray tube for the recording of electric frequencies free from inertia." Dr. J. Engl, H. Vogt, and J. Massolle. March 24th, 1921. (177,533.)
10,474. "Electrical time switches." F. Krupp Akt. Ges. May 23rd, 1921. (180,639.)
13,552. "Wired wireless telephone systems." Ges. fur Drahtlose Telegraphie. May 14th, 1921. (179,960.)
14,765. "Holders for electric lamps." W. S. G. Baker and J. Y. Fletcher. May 25th, 1922. (191,670.)
14,773. "Wireless signalling systems." British Thomson-Houston Co., Ltd. May 21st, 1921. (180,683.)
17,042. "Electrically-propelled mining machines." Sullivan Machinery Co. June 30th 1921. (182,458.)